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ABSTRACT

This publication presents the activities pertaining to the fourth goal of this activity guide series. The activities in this publication focus on the socioeconomic effects of energy uses and crises and the understandings needed to assess those effects. These materials are appropriate for middle school and junior high school students. These activities, organized by objective under the concepts listed, are interdisciplinary and can be used in many ways. The activities are simply ideas of things students can do to help them understand the concepts. It remains for the teacher to choose and implement those ideas as desired. Activities range from an experiment measuring sulphur dioxide in automobile exhaust to mapping the major sea lanes between oil producing countries and oil importing countries. (MR)

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IMPACTS of energy

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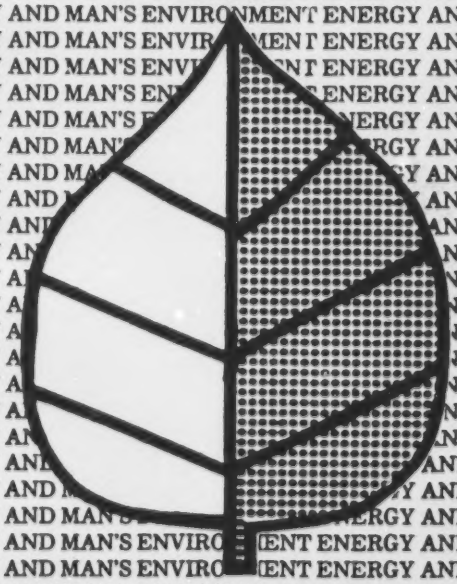

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SE 025 397

ENERGY AND MAN'S ENVIRONMENT

Activity Guide

An Interdisciplinary Teacher's Guide to

Energy and Environmental Activities

Section Four

IMPACTS OF ENERGY

John Jones, Editor

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IMPACTS OF ENERGY

Introduction

Every action creates environmental impacts. In the broadest sense, all dynamic elements of the living and non-living world impose both "positive" and "negative" consequences as a result of their very existence. The sun drives the photosynthetic process and contributes to the creation of deserts; backpacking influences erosion on mountain trails and strengthens the walker's cardiovascular system; forest fires destroy timber and eliminate diseases; building construction provides shelter and removes land from other uses; automobiles permit great mobility but use great, great amounts of resources in their manufacture and operation.

In man's shifting scale of values, the environmental impacts of his activities range from highly desirable and acceptable to completely undesirable and unacceptable; or from absolutely necessary to utterly frivolous. The determining factor in this judgment has historically been based on whether the results suited man's objectives, not the nature or degree of environmental disturbance. It is now apparent that we must begin to attend to the consequences of our acts. If we do not, in the inevitable struggle for equilibrium and balance by the ecological system, we may be judged inimical to the system's survival.

Knowing that our activities impose changes in the environment is not sufficient in itself. The rational act of anticipating the immediate and principle impacts of our activity with a relative degree of certainty is central to our ability to ensure equity between the growth of human society and environmental integrity. Energy is the essential

ingredient in our capacity to satisfy human needs. Since the exploitation of energy resources - exploration, extraction, refinement, transportation, combustion, et.al. - create some of our greatest environmental effects, it must receive our closest attention. In bringing power to the engines of human progress, we must weigh our self-interests against our final responsibility as rational beings in a shared biosphere. The "trade-offs" must be known. When care is exercised, there should never be a time when irreparable damage is done to the fragile link between the human race and the environment. The same intellect and technology that is, in one view, a threat to satisfactory environmental quality are at the same time, the instruments to preserve its integrity.

The skills essential to an understanding of how the world works and the resulting capacity to exercise anticipatory decision-making, should be a fundamental pursuit of the educational process. The need goes beyond problem-solving education; it demands an investment in an ekistical* experience. It requires an understanding of:

Interrelatedness. The principle of interrelatedness is illustrated by a cartoon which depicts two people standing in a street looking at a dead dog. One says to the other, "this is the dog that bit the cat that bit the rat that ate the malt that came from the grain that Jack sprayed."

Systems. The principle and recognition that everything is part of a system and that there is an interdependence of elements within each system.

*ekistical - the study of human settlements.

Dependency on nature. The principle that natural laws exist which we must understand and within which we must live. Thermodynamics, for example.

Growth and equilibrium. The principle that growth and adaptation are fundamental characteristics of life; but that each must occur within the limits of available resources.

Finiteness. The principle that the resources of the earth are limited to a specific quantity; and when once consumed, they are, for practical purposes, lost forever.

Conservation. The knowledge that systems in equilibrium practice conservation; that survival in a mutually dependent community depends upon the wise and efficient use of all resources.

In the final assessment energy and environmental ignorance is a crime with no defense. We must equip our youngsters for energy and environmental literacy. If our energy needs require negative environmental impact we must enter into that decision with full knowledge of the short and long-term consequences of our acts, and the legacy our decision will impose on generations yet unborn. Energy has the central role in our capacity to survive as a technologically advanced society within a quality environment. Education is the instrument for ensuring that the choices will be made rationally.

Dan Horn

EVALUATION

Impacts of Energy

The ENERGY and MAN'S ENVIRONMENT program actively seeks your ideas, comments, and general suggestions about this Activity Guide. If you feel there are ways this Activity Guide could be improved, or if more or different learning objectives or activities could be added, please let us hear from you. We plan to contact you in the near future to ask your opinion about the activities which you have used in your classroom. In anticipation of our request, we ask that you keep a careful record of all specific activities which are tried in your classroom. Please rate the effectiveness of each activity according to the following scale.

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion
			EXAMPLE		
Sources	III	B	2	✓	students enjoyed very much
Sources	III	B	5	✓	students enjoyed very much
Uses	II	A	3	✓	too difficult for age level

EVALUATION Impacts of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

EVALUATION Impacts of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: A - The student will know that gasoline fueled combustion engines endanger air quality.

activities

1. Measure SO_2 in auto exhaust with the following experiment:

   QUALITATIVE ANALYSIS OF SULFUR DIOXIDE IN THE AIR.

   SO_2 is produced primarily from the burning of sulfur-containing fuel. If excess oxygen is present during burning, some SO_3 is also produced. Both SO_2 and SO_3 combine readily with water to form sulfurous and sulfuric acids.

   $$SO_2(g) + H_2O \longleftrightarrow H_2SO_3 \quad \text{Eq. 1}$$
   $$SO_3(g) + H_2O \longleftrightarrow H_2SO_4 \quad \text{Eq. 2}$$

   The following is a description of a modified West Gaeke method which is extremely sensitive to SO concentration. This method uses common industrial dye called parasaniline hydrochloride.

   STEP I - An air sample of 10 to 40 liters is bubbled through an absorbing solution containing tetrachloremercurate (II) ion, which fixes the SO_2 in the air by the following reactions:

   $$SO_2(g) + H_2O \longleftrightarrow H_2SO_3 \quad \text{Eq. 3}$$
   $$HgCl_4^{=} + H_2SO_3 \longleftrightarrow (HgCl_2SO_3)^{2} + 2\,Cl^{-} \quad \text{Eq. 4}$$

   A stable complex, dichlore sulfite mercurate (II) ion, is formed. By forming a solution of this stable SO_2 derivative in the field, the fixed SO_2 can be taken back to the laboratory for further analysis with no loss of SO_2.

   STEP II - In the laboratory, formaldehyde is added, causing the following reaction:

   $$2H^{+} + (HgCl_2SO_3)^{=} + HCHO \longleftrightarrow Hg^{++} + 2Cl^{-} + HO\text{-}CH_2\text{-}SO_3H \quad \text{Eq. 5}$$

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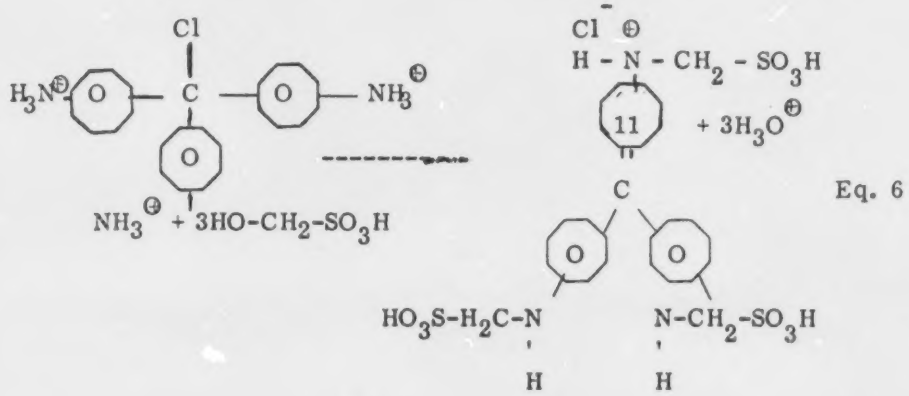
Concept I
Objective A

STEP III - Addition of green-yellow, acid bleached parasaniline hydrochloride produces on reaction with the product of Step II the intensely reddish-purple parasaniline methyl sulfonic acid. The reaction shown in equation is slow and the complex formed is not very stable.

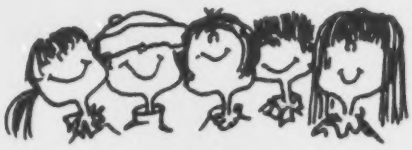


Eq. 6

During the development of the colored product the solution should be protected from strong light. The above illustrates the Schiff reaction between parasaniline, formaldehyde and sulfur.

REAGENTS

0.1 mg Na_2HgCL_2 Solution: Mix 27.2 gm $HgCl_2$ (0.1 mele) and 11.7 gm NaCL (0.2 mele) per 1000 ml



If NO_2 is present it will hinder the reaction. If you suspect NO_2 add 0.6 gm amidesulfonic acid to 1 liter of Na_2HgCl_2 solution.

Formaldehyde Solution: Use a 0.2% solution made as follows: 5 ml 40% formaldehyde made up to 1000 ml.

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activities

Concept I
Objective A

Parasaniline Solution: Make up a 1.0% solution by weight and allow to stand for 24 hours to compensate for hydrolysis.

Combine 4.0 ml of the 1.0% parasaniline solution with 6 ml concentrated HCl and shake until brown color disappears, make up to 100 ml.

PROCEDURE:

1. Pass the gas through 100 ml of Na_2HgCl_2 solution over a period of 10 to 30 minutes.
2. Add 10 ml of formaldehyde solution.
3. Add 10 ml of parason _____ hydrochloride solution.

RECORD OBSERVATIONS.

2. Prepare six 3" x 4" cardboards heavily coated with vaseline. Go to the school parking lot. Choose large, small, old and new models of cars. Include one with a pollution device, if possible. Having obtained the permission of the car owner, start the car's engine and collect exhaust emissions on the cardboard by holding the cards directly behind the exhaust pipe. Record the year and make of car on the cardboard. Be sure to run each engine for the same length of time. Compare the cardboards and discuss the findings.

3. Test exhaust emissions from a model airplane gasoline engine; choke the engine in order to produce emissions with higher concentrations of pollutants. Collect the emission gases by attaching tubing from the exhaust outlet to a large plastic bag. Make all connections airtight by using tape if necessary.

   The tubing should run through a bowl containing ice and salt. This will trap moisture so various pollutants can be detected.

   a. For SO_2
      Use potassium permanganate ($KMnO_4$) 0.25g per liter of distilled water. SO_2 will decolorize the dark purple solution.

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activities

Concept I
Objective A

b. Lead
Use a solution of 20 ml of water, 10 ml of concentrated acetic acid and 10 g of chromic anhydride (CR O_3). The amount of yellow precipitate of lead chromate formed is a measure of lead compound in the gas.

c. For CO
Use half of a supply of beef blood to receive the bagful of exhaust emissions. Note the difference in colors. Carbon monoxy-hemoglobin forms a darker color than oxy-hemoglobin.

d. For CO_2
Pass gas through lime water solution, Ca $(OH)_2$. The white sediment formed is $CaCO_3$, limestone.

4. Divide class into groups. At a different time each day, each group will inventory traffic at a location near the school, recording its findings on a classroom chart.

Date	Time	No. of Vehicles	Vehicles emitting black exhaust	Noisy Vehicles

After all groups have reported, class can tally the last three columns and figure the percentage of vehicles which are polluting air or noise level.

5. Describe five ways in which the automobile is helpful to man. Describe five ways in which the automobile harms the environment. Include, but do not limit your list to such factors as sight, smell and hearing.

6. Using book jackets (dust covers) or "paper backs", arrange a display on a bulletin board (or showcase) as a "Read Up On Earth" campaign.

7. Tie white muslin collecting bags on the exhaust pipe of a small automobile, a large automobile, a bus, a diesel truck and a motorcycle for one minute each. Compare the findings.

For a 24 hour period set squares of white paper inside a house, inside and outside a school, near a manufacturing plant, and in the downtown area. Compare the findings.

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activities

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concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: B - The student will know that energy production plants affect environmental conditions.

activities

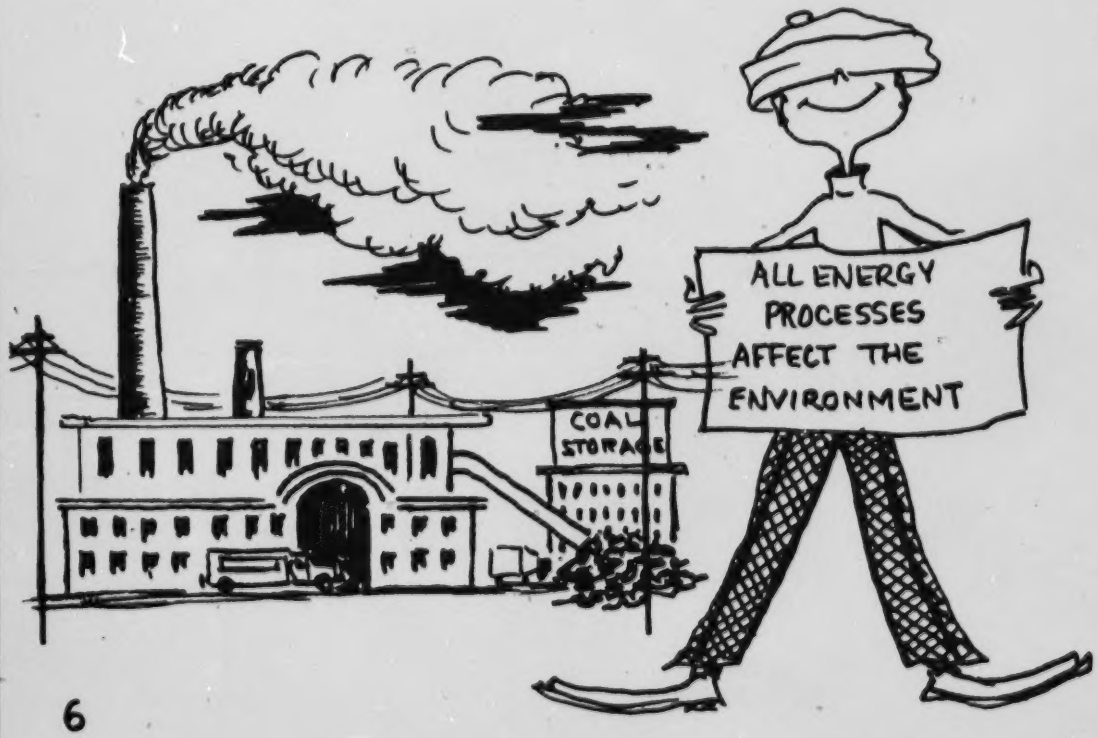
1. State the effect on the environment for each of the following power plants:

   a. plant burning coal
   b. plant burning oil
   c. plant burning natural gas
   d. hydroelectric
   e. nuclear
   f. geothermal
   g. tidal
   h. solar electric plant

2. State the kind of fuel-fired electric plant you would prefer as a neighbor, and defend your choice.

3. List ten impact benefits of energy from a power plant.

4. List five advantages and disadvantages of locating central electric energy power plant stations in the population area; in rural areas.



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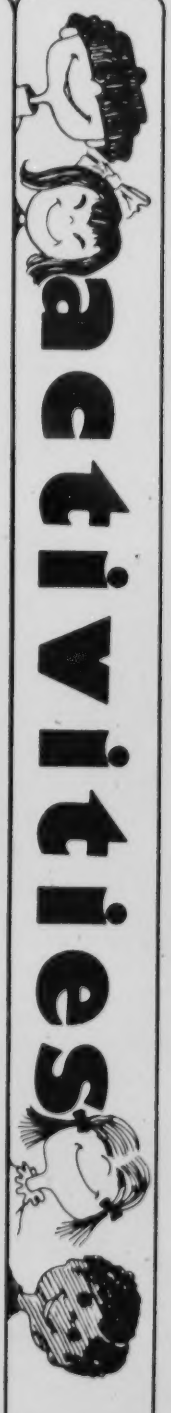
concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: C - The student will know that sewage treatment plants improve environmental conditions.



1. List three ways a sewage treatment plant improves the environment.

2. Visit a small stream or pond. Using a water testing kit, make the following tests - temperature, CO_2, SO_2, pH. Using the charts in Field Study Manual for Outdoor Learning by Milliken Hamer and McDonald, predict what life will be found in the stream or pond.

   With a small collecting bottle (clean plastic medicine bottles are excellent), collect specimens from the stream or pond. Compare these specimens for temperature, CO_2, SO_2, and pH.

   Set up a hypothetical case in which one of the factors is varied (increased or decreased by some means) and try to predict what will happen to stream life.

   Later, visit and test a lake, pond or stream along which there are many residents or businesses. Make the same tests and record the results. What are the results?

3. Water Pollution:

   Use water and yeast (or sewage) to demonstrate biochemical oxygen demand (B.O.D.).

   Pour 3 ml of milk into a cup containing 20 ml of water. Add 1 level teaspoon of dry yeast to a second cup containing 20 ml of water. Stir thoroughly.

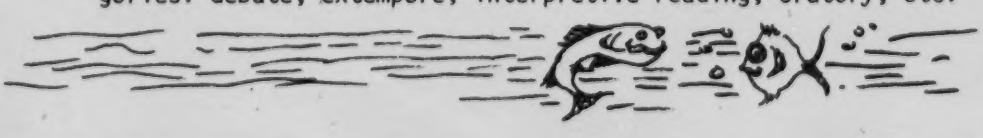
   Use methylene blue to indicate the presence of oxygen. If oxygen is consumed, the indicator becomes colorless.

   Milk represents sewage and yeast represents decay organisms.

   Using test tubes (or small cups) make various mixtures and observe changes. One half hour may be required before the yeast may be able to cause observable change.

   Discuss how the food supply is related to organisms of decay. When oxygen is consumed, what happens to fish?

4. Write speeches or organize a debate tournament covering a broad range of environmental subjects. Cover all of the speech categories: debate, extempore, interpretive reading, oratory, etc.



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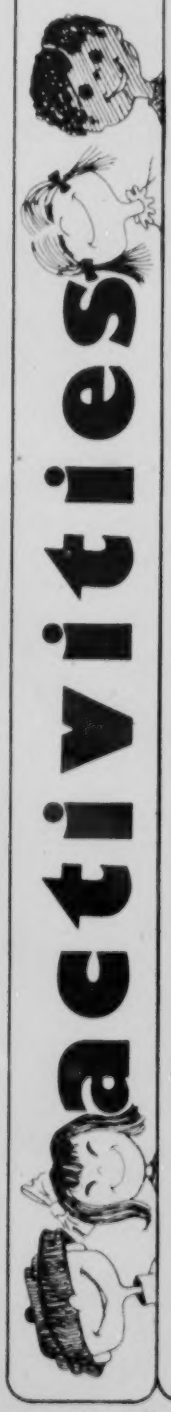
concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: D - The student will know that petroleum and its derivatives degrade water environments.



activities

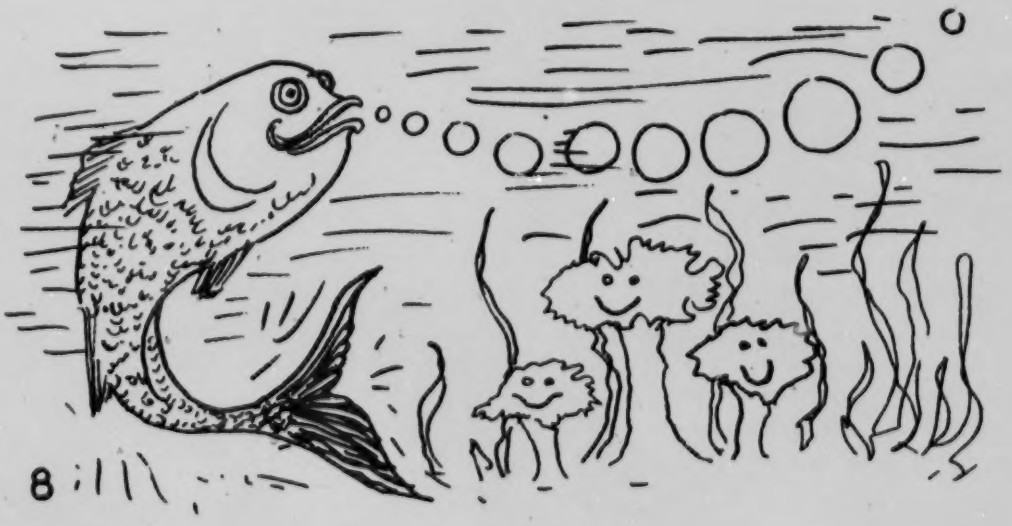
1. Take photographs of different scenes in the community. Show water pollution by oil and garbage and take photos of non-polluted areas for contrast. The photographs might be made into slides, and a slide show prepared, accompanied by student commentary.

2. Write a play using the ingredients of polluted air or water as characters. Develop the theme of their impact on the environment and people. Design, make or build the costumes. Present the play to a variety of audiences - parents, the elderly, schools, and classmates.

3. Organize a campaign of "Communication Through Visual Symbols" by collecting large posters on environmental protection, land use, conservation, etc. Build a kiosk (from old paper drums) and display a new set of posters every few days.

4. Assemble a record collection of modern ballad singers (Buffy St. Marie, Pete Seeger, Judy Collins, Phil Ochs, Joan Baez, Melvena Reynolds, Johnny Cash, the Limelighters, Burl Ives, Jack Elliot, Jim Croce, John Denver, Gordon Lightfoot, Arlo Guthrie, Woodie Guthrie, Tom Leher, etc.) Tape record those sections that express environmental concerns. Pipe the music into the lunchroom.

5. Locate two different government or industry examples of how improvements can be made to have less impact on the environment. Include in program of activity #1.



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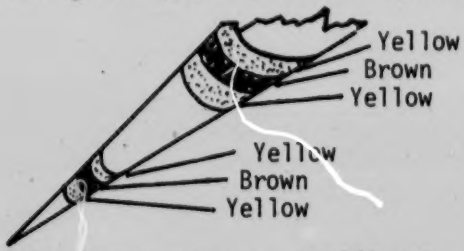
concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: E - The student will know that all air varies in the quantity of pollutants it carries.

1. Take a sheet of glass or cardboard about 3" x 3". On the surface put masking tape with the sticky side up. Locate the plates at various places indoors and outdoors where the air is suspected to be clean and where it is suspected to be polluted. After several days, collect the sheets and examine what has collected there.

2. Collect young white pine needles from several areas and examine them for evidence of damage by sulfur dioxide. Damage is indicated by discolored bands on the needles.



If the damage appears significant, plot the geographic areas where the worst needles came from and attempt to determine why the damage has occurred in those areas.

3. Obtain several pieces of clean cheesecloth and prepare a set of frames, made from wire or wood strips. Place these cheesecloth "pollution gatherers" in different locations which have single sources of possible air pollution. Examples:

   a. Near a freeway.
      In fixed intervals from a smokestack e.g., 100 yards, 200 yards, 400 yards, 800 yards.
      Near a gravel pit.
      Near a dusty dirt road.

   b. Compare the color changes observed from each site. Examine your cloths under a microscope.

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Concept I
Objective E

c. What impact would each of the following variables have on the experiment?

1. Use of differing sizes of cheesecloth.
2. Distance from the ground.
3. Length of time for exposure.
4. Prevailing wind direction.
5. Multiple effects (freeway located near industrial smokestack).
6. Time of day.
7. Time of year.
8. Any others?

d. How could this experiment be improved so that the variable of gathering the pollutant could be made more precise?

4. Using the Northwest Indians as a basic art history resource, design and build masks that are symbolic of "The Good and Evil Spirits of our Environment".

   Construct a "totem" of environmental concerns.

5. Arrange a display on a bulletin board as a "Read Up On Earth" campaign.

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concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: F - The student will know all humans are polluters.

activities

1. Collect a series of cartoons depicting the effect of energy use on the environment.

2. Write a speech for your state's governor which he can use to address the state legislative branch on the effect of energy use on your state's environment.

3. Write an environmental prayer which expresses your perceptions of the effect of energy use on the environment.

4. Demonstrate the general ignorance of even well-educated people about the impact on the environments of energy activity by asking ten adults the following questions:

   a. What was the effect of the Rainbow Bomb on the Van Allen Belt?

   b. In what ways might jet airplanes change the weather system?

   c. Did Harry Truman, Winston Churchill and Clement Attlee know about the biological effects of radioactivity before the Hiroshima atomic bomb blast?

   d. What was the basic miscalculation that produced atmospheric distribution of strontium 90?

   e. What will happen to the earth's life forms if the earth's mean temperature rises 3° Centigrade?

   f. What have been the environmental effects created by the construction and use of the Aswan Dam?

   g. What effect has the discovery of Prontosil had on environmental alteration and energy demand?

   h. Was Ian McHarg's "Plan for the Valley" near Baltimore fascist, socialistic, capitalistic, or communistic?

   i. How long will it take for the United States to reach saturation in manufactured goods?

P.S. Know the answers before giving the test.

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activities

Concept I
Objective F

5. Create a series of improvisations dealing with the use of energy and the impact of that use on the environments you know.

6. Write a column for your school newspaper under the adopted bylines of Art Buchwald and Irma Bombeck.

DEBATE
CONFLICTS IN JUDGMENTS
THE NORTHWESTERNER
SILVERCULTURE PRACTICES CURRENTLY USED BY FORESTERS IN THE DOUGLAS FIR, N.W.

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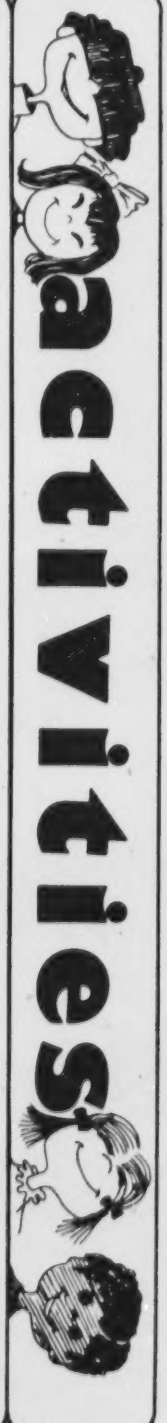
concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: G - The student will know that energy extraction impacts the environment.



activities

1. Compare the environmental impact of surface and deep mining of coal and uranium.

2. List three ways a mining area may be restored following the mining operation.

3. Surface mined coal in the eastern and western United States differs in sulfur content. The higher sulfur eastern coal results in mine acids (sulfuric acid) that make the land difficult to reclaim by vegetation planting. Western coal mining operations are usually in arid regions with a delicate terrestrial ecosystem. Compare the types of vegetation used in reclaiming the land. Compare the difficulties of reclaiming the land.

4. Write three oil companies requesting information on the various methods they use for reclaiming the land. Compare the methods used and note differences in methods for various types of geological areas.

5. List three energy industries and/or government agencies. Contact each one asking for sample copies of their environmental impact statements. Compare the impact statements noting common areas of discussion. Then note differences in the various impact statements. List major items you believe should be covered by the individual impact statements. Write a letter to each of those organizations involved providing your recommendations and ask the organization for a reply.

   Some organizations that prepare environmental impact statements: oil companies, electric utilities, state highway department, all government agencies involved in new facilities i.e. recreation, energy, transportation, waterways, large agricultural projects like irrigation, mining industries.

6. Ask a local industry or government representative to visit your class to discuss the use of environmental impact statements.

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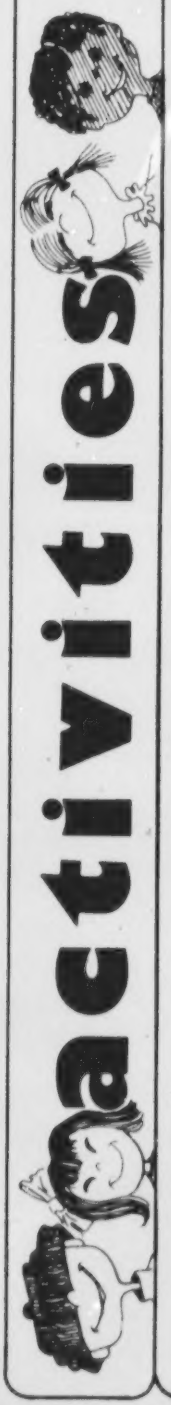
concept: I - Energy extraction and use alters original environmental conditions.

impacts

objective: H - The student will know that intensity of energy use produces sociologic changes within and among human population groups.



activities

1. Identify historical instances indicating the sociological impact of increased energy use on given human population groups.

2. Organize a campaign of "Communication Through Visual Symbols" by collecting large posters on environmental protection, land use, conservation, etc. Display them in a showcase or on the bulletin board.

3. Collect records of modern ballad singers, edit just for environmental message songs, tape and play over intercom during lunch.

4. Collect poems that express environmental concerns. Using contemporary calligraphy, print up and distribute to other classmates, give as gifts, or type, reproduce and bind into small "pocket anthologies - environment."

5. Divide into groups to write "environmental" poems, limericks, (remember the Burma-Shave signs?) compose songs, write a skit and put on a variety show (put it "on the road" to other classrooms and/or schools.) Build simple sets or portable props for each "talent" sequence.

6. Write and design environmental bumper stickers. Reproduce (on recycle stock) and distribute as part of a community awareness campaign.

7. Write speeches covering a broad range of environmental subjects.

8. The American population's economy, excluding construction, earth moving, and many other operations, uses 2,500,000,000 tons of environmental materials a year. That is nearly 13 tons a person. Describe the environmental impact of the energy use it took to move your neighborhood's share of that material on the place where you live, during this past year.

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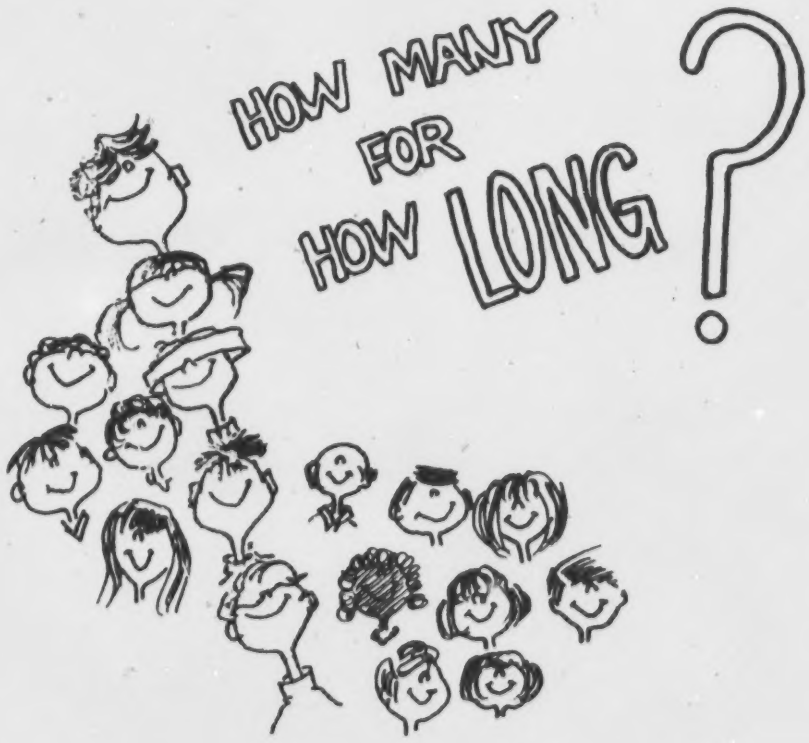
concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: A - The student will understand that the only lasting solution to declining energy resources is a world population decline.

activities

1. Determine the maximum population that could live in the U.S. and not deplete our major natural resources.
2. Develop a model recycle society giving ways the recycling of materials could best be utilized.
3. Compare the energy savings in a recycle society to a non-recycle society of the same population.



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concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: B - The student will understand that any change in present energy use will affect employment patterns.

activities

1. If it is true that some packaging is non-essential, and is thereby a wasteful use of natural resources (raw material and energy), what specific jobs would be affected by the elimination of excessive packaging?

   a. List jobs affected.

   b. Determine whether an increase or decrease in the cost of the item would result.

   c. What problems of shipping and storage would result?

   d. Itemize sanitary implications for ten grocery or drug-store items that are edible.

   d. Explore other economic implications.

2. Describe the implications of an attempt to control pollution from internal combustion engines.

3. Tour the power generating plant that supplies your city. Determine whether this is the best site on the basis of power source, transmission line length, impact on the immediate environment, impact on the city's environment.

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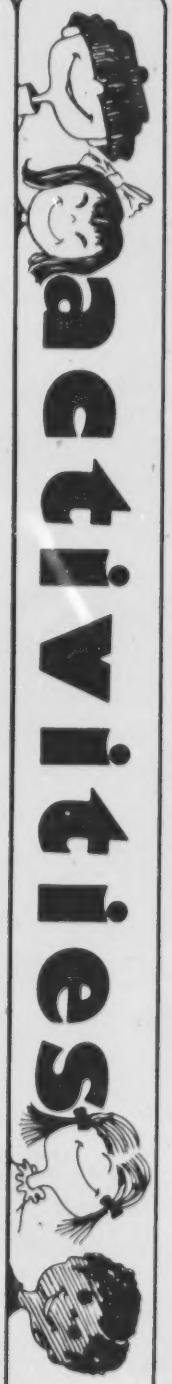
concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: C - The student will understand that industrial and automobile emissions damage man-made and natural structures.



1. Today in Europe there are many ancient statues and buildings that are in danger of being dissolved or permanently disfigured, not by vandals but by something else.

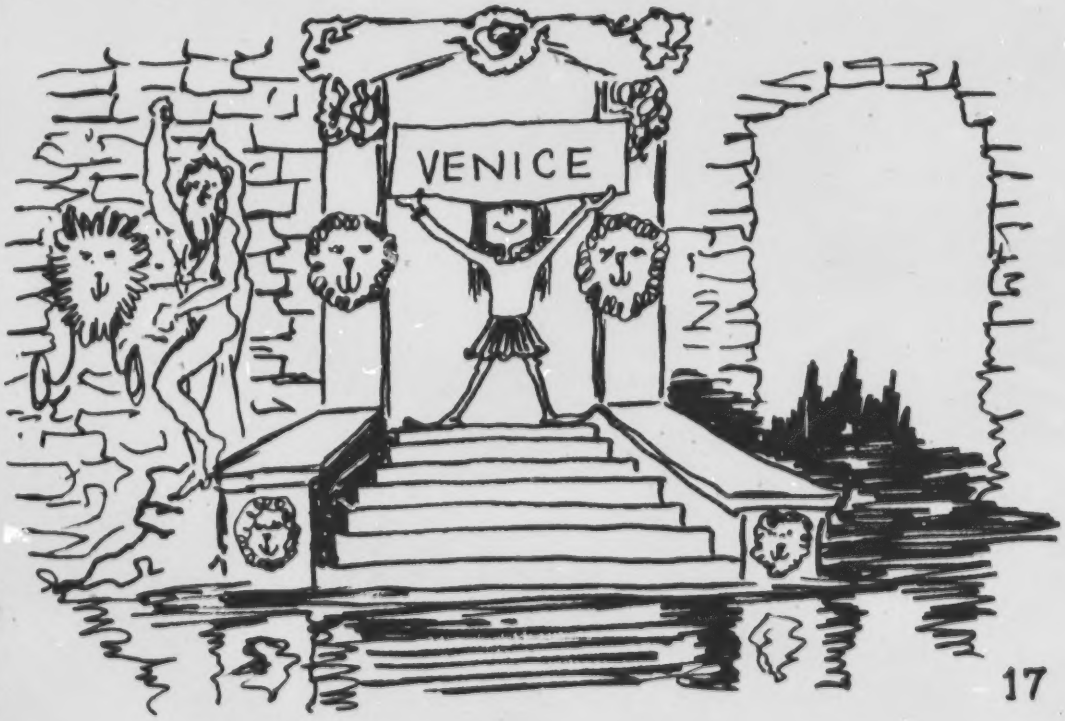
   Solve this mystery.

   a. Who or what is causing the destruction?
   b. How can it be stopped?
   c. Should we worry about this problem?

2. Gather information on the effects of auto emmissions on works of art (sculpture and architecture). Pay particular attention to Rome, Venice, Florence, and Mexico. (Good resources: The Smithsonian Institute in Washington, D.C.)

3. Identify five industrial plants in your community and determine why they may be emitting polluting substances into the atmosphere.

4. Identify how auto emissions cause deterioration of statues, art pieces, etc.



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concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: D - The student will understand that the site selection and design of industrial plants which use power involve environmental trade-offs.

activities

1. Tour the power generating plant that supplies your city. Determine whether this is the best site on the basis of power source, transmission line length, impact on the immediate environment, impact on the city's environment.

2. It is not always possible to construct an electrical energy-producing power plant in the most desirable location. Suppose your geographic area needed more electric energy. Establish a set of criteria (rules or standards that you would apply to judge the desirability or undesirability) that might be used in studying where to locate a plant.

   Include these elements in the criteria:

   a. Location of plant
   b. Prevailing wind direction
   c. Water sources
   d. Fuel sources
   e. Economic impact
   f. Environmental impact
   g. Aesthetic considerations

3. Identify and discuss the environmental trade-offs which make possible off-shore drilling.

4. Assume that it costs about 20% more to build a dam with locks which would allow for shipping purposes. Assume also that an ideal dam site has been developed, but the citizens (ratepayers) are opposed to the increased costs. How could you defend or oppose the building of locks in the dam?

5. Identify the government agency(s) in your state responsible for providing permits to build an electrical generating station. Obtain a copy of their regulations and evaluate the merits of each rule.

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concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: E - The student will know that different energy users advocate different environmental trade-offs.

activities

1. Study some magazine advertisements about energy and power. Then formulate advertisements that reflect the point of view of the:

   a. Power producer
   b. Environmentalist
   c. Old Mother Earth
   d. Manufacturer's association that asks for a personal commitment by citizens to reduce the need for additional energy in your life.

   Present the advertisements to the class or PTA and ask for reactions from the audience.

2. Have all sources of power to the classroom turned off. Discuss those sources which are absolutely necessary to the school. Discuss alternate sources which contribute less pollution that might be substituted for those presently in use.

3. Using Congressional hearing documents, identify the points of view of contending parties giving testimony about environmental controls of energy production.

4. Identify and discuss the environmental trade-offs which make possible off-shore drilling.

5. Write a dialogue about an oil spill that takes place between an oil drenched seagull and a homeowner in Montana who can't buy fuel oil to heat his home.

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concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: F - The student will know that different national people advocate different environmental trade-offs.

activities

1. Trace the debate currently involving the use of the off-shore oil in Scotland and Norway.
2. Gather information on the effects of auto emissions on works of art (sculpture and architecture). Pay particular attention to Rome, Venice, Florence, and Mexico.
3. List five reasons for the U.S. population having a large number of automobiles.

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concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: G - The student will know that the movement of people and goods requires environmental trade-offs.

activities

1. Contrast the use of rapid transit systems with automobile use by individuals.

2. List all forms of freight transportation, beginning with the one which least affects the environment, and continuing in progressive order, to the one with the greatest impact.

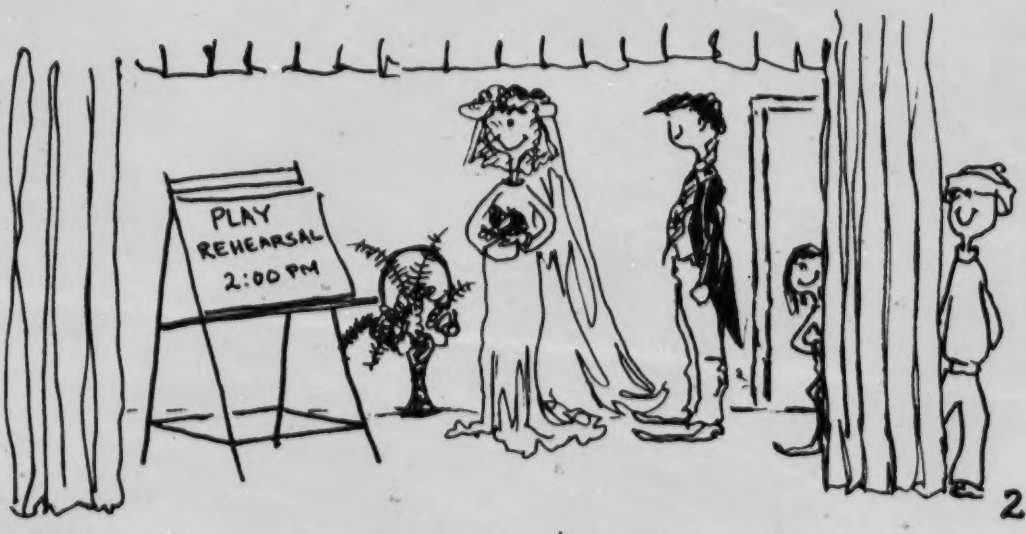
3. Write and act out a play in which all the dialogue is intended to:

   a. Reflect the character types' sense of values

   b. Express the weakening effect of the insecurity produced in human behavior in facing loss of prestige, position, wealth, etc.

(Bibliography):

Islandia	by August T. Wright
Walden II	by B. F. Skinner
Island	by Aldous Huxley
Flatland	
Ship of Fools	
Raintree County	
Looking Backward	by Ralph Bellamy
Typee	by Herman Melville
The Ugly American	



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concept: II - The use or non-use of any energy source requires environmental trade-offs.

impacts

objective: H - The student will understand that the decisions people are willing to make about environmental trade-offs are based on internalized values.

activities

1. Identify the values espoused during a classroom debate on the environmental trade-offs between those who argue for prosperity and those who argue for posterity.

2. In a small group discuss these questions:

   a. Why do we spend our lives amid a haphazard squalor that God never made, nature never evolved, and man never intended?

   b. Man is the dirtiest animal.

3. Write and act out a play in which all the dialogue is intended to:

   a. Reflect the character types' sense of values.

   b. Express the weakening effect of the insecurity produced in human behavior in facing loss of prestige, position, wealth, etc.

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concept: III - Various energy sources have differing impacts on the environment.

impacts

objective: A - The student will understand that various energy sources and uses have differing impacts on the environment.

activities

1. Within five minutes, list as many examples of pollution as possible. Tell what the benefits to mankind would be if they were eliminated.

2. Compare the temperature effects on water from the following:

   a. nuclear power plants
   b. hydroelectric plants
   c. fossil fuel plants

   Do these change life in the water? In what ways?

3. Describe various methods of transporting energy producing material from source to point of use, and the effects of that on the environment.

4. Describe the pollution generated as a by-product from each type of power plant.

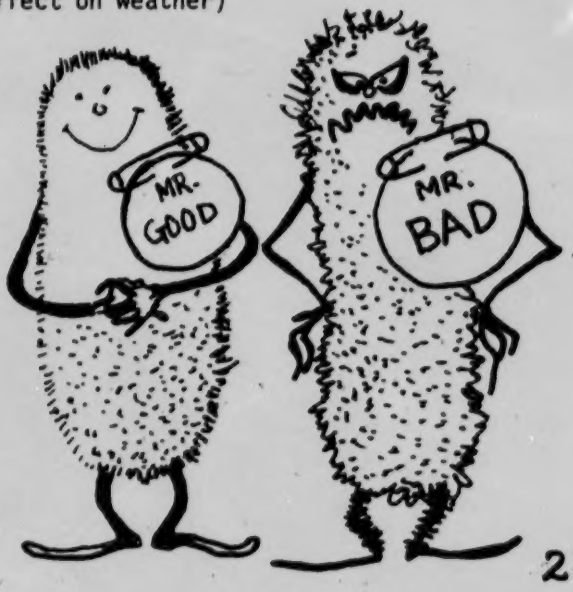
5. Describe the harmful or beneficial effects of each of the following:

   a. In air:

      1. CO
      2. CO_2 (global effect on weather)
      3. NO
      4. PAN
      5. SO_2
      6. Particles
      7. Lead oxide

   b. In water:

      1. Petroleum
      2. Pesticides
      3. Mercury
      4. Cadmium
      5. Copper
      6. Lead
      7. Garbage
      8. Acids
      9. Soap
      10. Mine wastes



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Concept III
Objective A

c. Thermal:

   1. Bacteria
   2. Algae
   3. Fish
   4. Oysters
   5. Crabs, lobsters

d. Radioactive wastes

e. Solid wastes:

   1. Mine tailings
   2. Overburden from strip mining
   3. Transportation of solid wastes

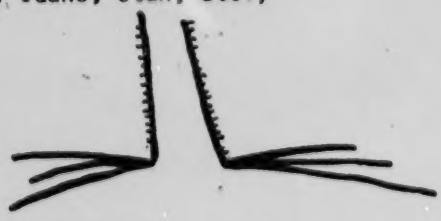
f. Noise

g. Visual (road signs, etc.)

6. Identify the various pollution control devices and procedures used in a nuclear power plant.

7. Write and illustrate a "Monster Book" for your classmates using one of the following titles:

   a. Monster and the Snowmobiles
   b. Monster and the Gas Shortage
   c. Monster Builds a Dam
   d. Monster and the Oil Slick
   e. Monster Builds a Power Line
   f. Monster Visits Bonneville Dam
   g. Monster Mines Coal
   h. Monster's Trip to Trojan Reactor
   i. Monster Builds a Power Line
   j. Monster Takes the Bus to Town
   k. Monster Rides a Dune Buggy
   l. Monster Builds a Canal
   m. Monster Settles Oregon (Washington, Idaho, Utah, etc.)
   n. Monster Gets an Air Conditioner
   o. Monster Visits a Copper Mine
   p. Monster Builds a Boat
   q. Monster Visits a Sawmill



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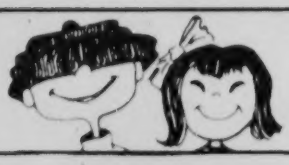


activities

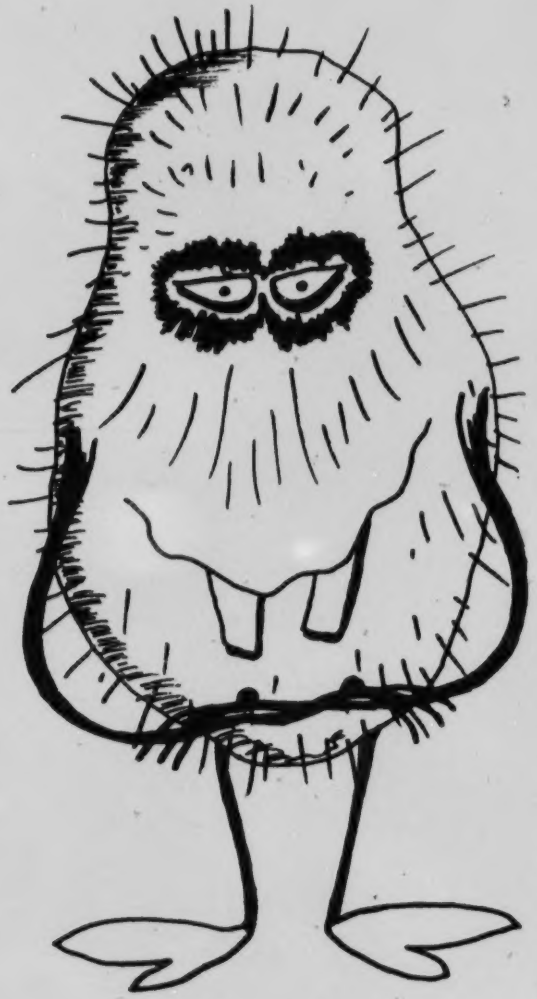
Concept III
Objective A

7. Continued:

   A "Monster Book" is a common term used to describe a student-made book with a friendly "Monster" who has various adventures. The student writes and illustrates the story and the books are shared by the children.

8. Write the autobiography of a river.

9. List some alternatives to internal-combustion energy.



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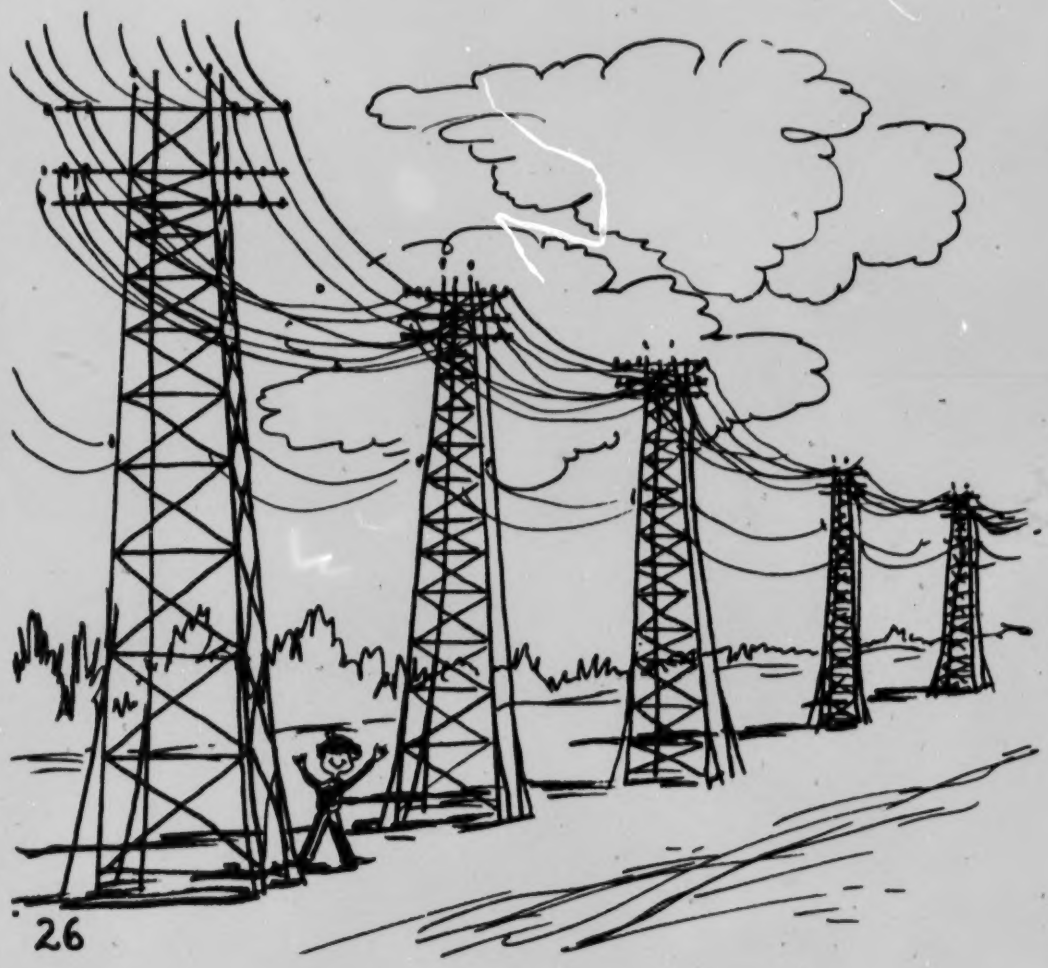
concept: III - Various energy sources have differing impacts on the environment.

impacts

objective: B - The student will understand that transportation and transmission of energy have an environmental impact.

activities

1. Contrast the economic and environmental impacts of a pipeline transporting coal, truck transportation of coal, oil and gas, rail transport and ship transport.
2. Describe various methods of transporting energy producing material from source to point of use, and the effects of that on the environment.
3. Determine how many acres of land are required to accommodate a high voltage transmission line for 10 miles.
4. List some uses of the land located under transmission lines.



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concept: III - Various energy sources have differing impacts on the environment.

impacts

objective: C - The student will understand that different energy activity produces heat in differing amounts.

activities

1. List the arguments favoring nuclear energy over other sources in or near population centers (so that the excess heat produced by the plant can be used by the community).

2. Explain why thermal power plants (nuclear and coal) release waste heat to the environment. The laws of thermodynamics would need discussion to answer this question.

3. Describe how Sweden has used central generation power plants to generate electricity and provide space heating to the city. How does this save energy?

4. Explain why most thermal power plants in the U.S. are unsatisfactory for space heating.

   a. Consider the temperature of the discharge water.

   b. Consider the locations of thermal power plants to population centers.

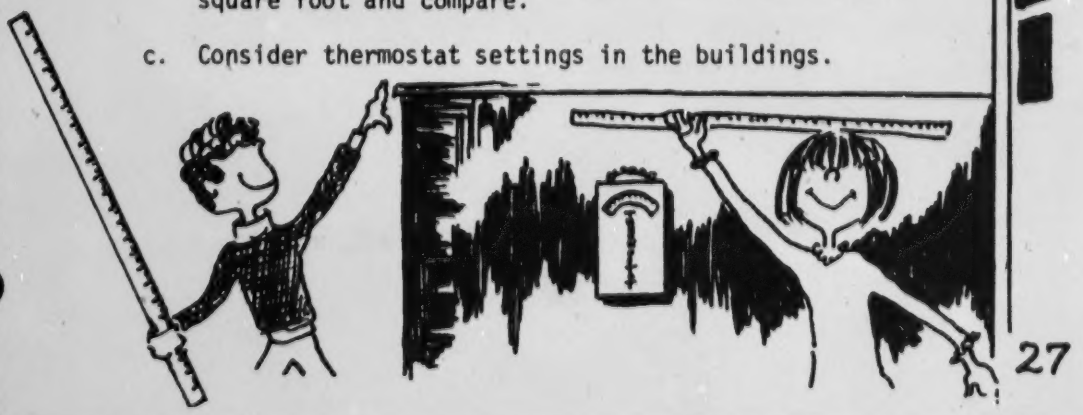
   c. Consider the costs of a new central power station heating system for use in a new community development versus an existing community.

5. Compare the energy savings of space heating from a central station system on a university campus or some local government buildings to alternate methods of space heating units for individual buildings. Some things to consider:

   a. Determine the floor space and ceiling heights of the buildings.

   b. Determine the annual building space heating costs per square foot and compare.

   c. Consider thermostat settings in the buildings.



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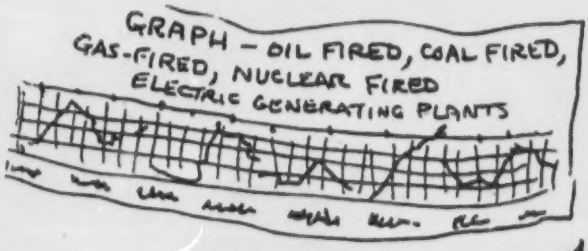
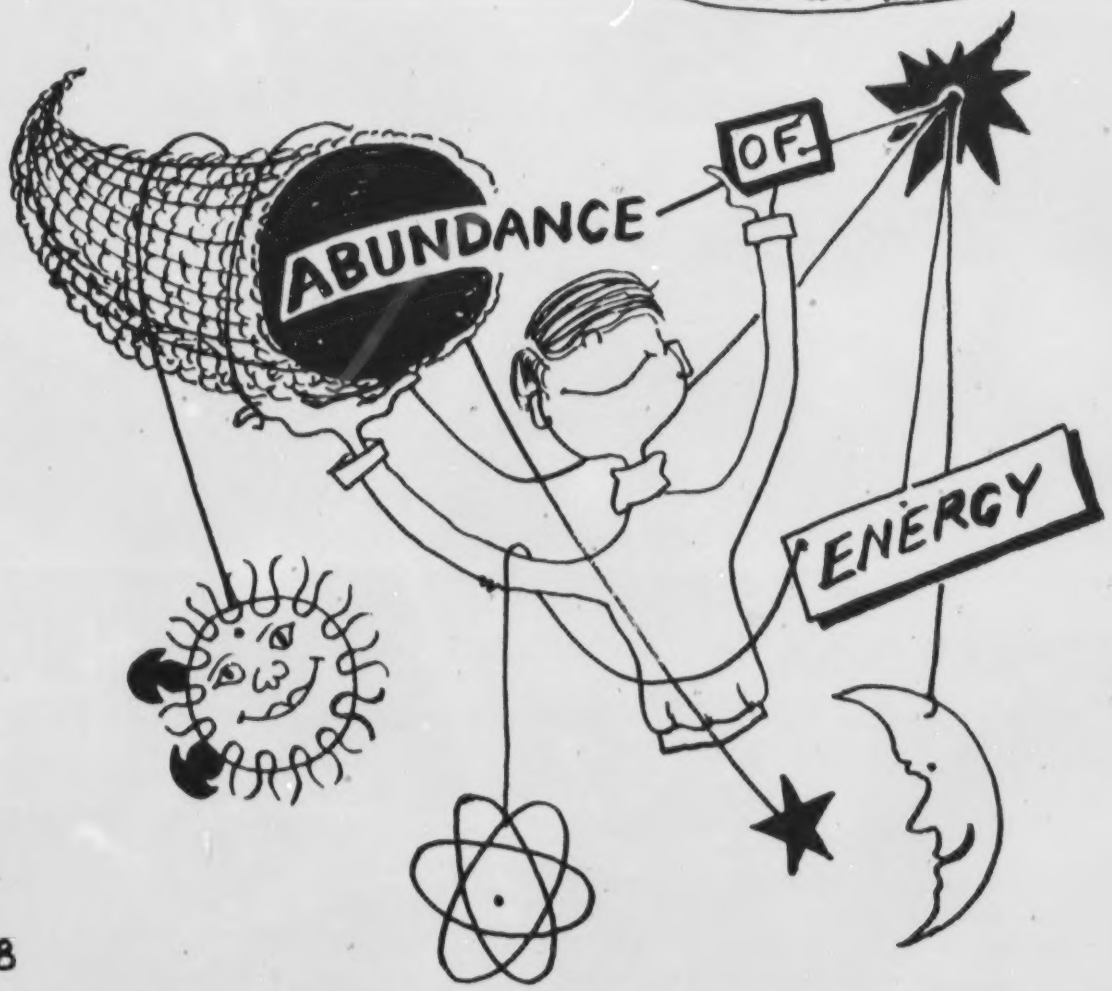
Concept III
Objective C

6. Graph the cost of heating your home, your school, or office building using:

   a. a gas furnace
   b. an oil furnace
   c. a heat pump
   d. nuclear/electricity
   e. coal/electricity
   f. sawdust
   g. oil/electricity
   h. gas/electricity
   i. nuclear/H_2





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concept: III - Various energy sources have differing impacts on the environment.

impacts

objective: D - The student will understand that land use differs as energy use differs.

activities

1. Identify the different uses of land between an industrial society and a primitive agrarian society.
2. Compute the amount of solar radiation received at 60° north latitude and at 35° north latitude, then compare the two desert environments which occupy these locations.
3. Discuss the potential industrial growth of an area as a result of siting a power plant in the area.
   a. Consider the land use.
   b. Form a planning commission and determine how the land might be used, i.e., residential, industrial, recreational, commercial, agricultural, etc.
   c. Consider various types of power plants, i.e., hydroelectric, nuclear, coal, solar, geothermal, oil/gas, etc.

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concept: III - Various energy sources have differing impacts on the environment.

impacts

objective: E - The student will understand that a marine environment reacts differently to oil activity than does a land environment.

activities

1. Identify the effect of crude oil contamination on a coastal marine environment and identify the rate at which that environment recovers.
2. Identify the effect of crude oil contamination on agricultural land and the rate at which that environment recovers.
3. Identify the effect of crude oil contamination on a fresh water river and the rate at which that environment recovers.

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concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

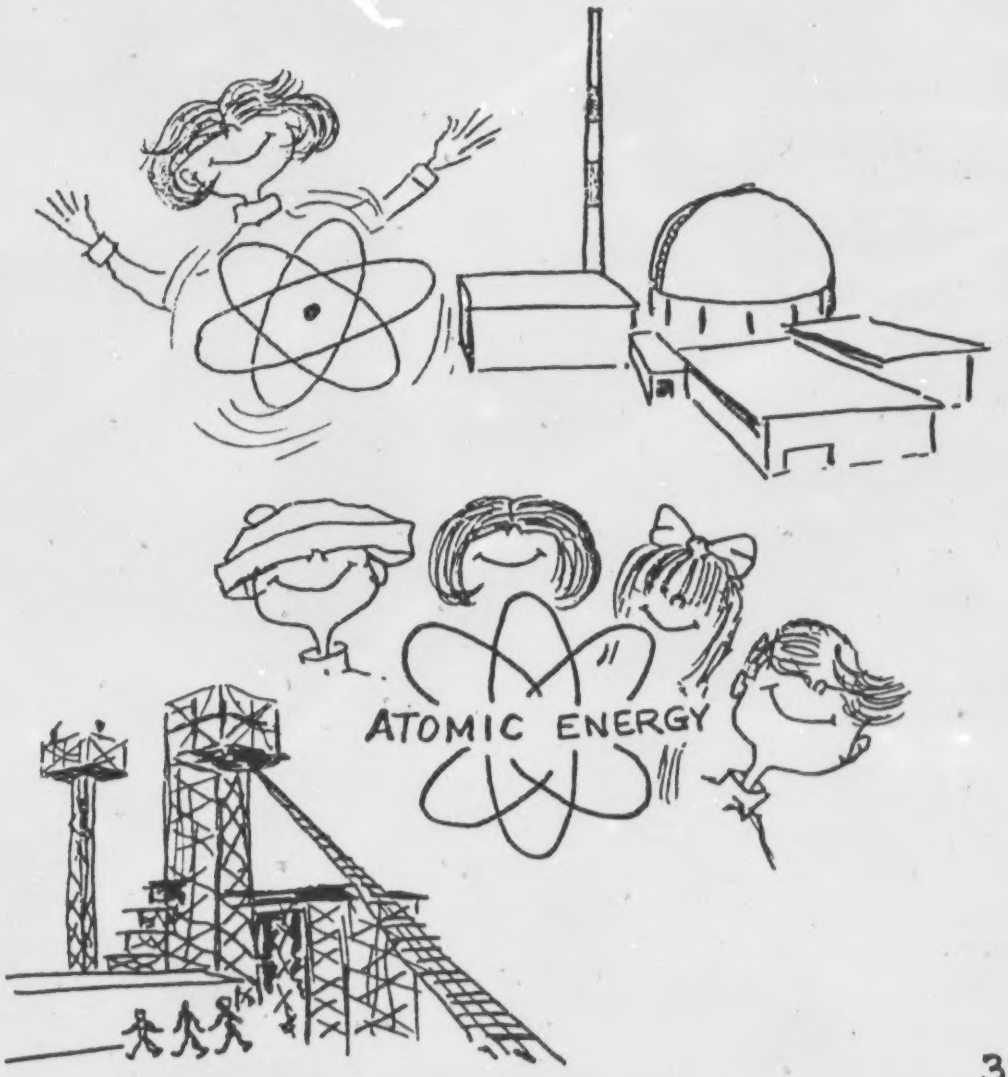
impacts

objective: A - The student will understand that conflicts over ecologically sound practices and aesthetic judgments can be resolved.

activities

1. Identify your personal vested interests relating to energy and biotic ecosystems.

2. Identify the ways your local energy production industry has successfully obtained ecologically sound operations and aesthetic looking facilities.



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concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

impacts

objective: B - The student will understand that some of these conflicts can be resolved by empirical processes.

activities

1. Go to the County Planning Commission. Examine land use plans. Examine topographic maps with drainage patterns and determine the best locations for the county dumps and sewage treatment plants. Compare with their actual present locations.

2. Using a noise level meter (either decibel meter or recording level meter on a tape recorder), check the noise level at various places in the community - downtown street level, lunchroom, gymnasium, freeway, race track or drag strip, department store, train, industrial shop, park, back yard, office interior.

3. Design and conduct a poll to find out how homeowners and residents of apartment houses feel about the advantages and disadvantages of heating with oil, natural gas, coal or electricity.

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concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

impacts

objective: C - The student will understand that some of the conflicts can be resolved by legal process.

activities

1. Define the rights of each individual to power resources.
2. Describe appropriate recycling laws.
3. Describe how air pollutants destroy the beauty of the environment.
4. Describe the impact of recreational vehicles on the environment. Include the family automobile when used for recreation.

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concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

impacts

objective: D - The student will understand that some conflicts can be resolved by design processes.

activities

1. Describe four ways energy can be used to beautify surroundings, e.g., to move water to support life, etc.
2. Describe how air pollutants destroy the beauty of the environment.
3. Compare the ecological impact of wind generated energy with the aesthetic impact caused by the appearance of the windmills.
4. Design an aesthetically pleasing windmill; display products.
5. Design an aesthetically pleasing solar collector.

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concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

impacts

objective: E - The student will understand that some of the conflicts can be resolved by technological recycling processes.

activities

1. Describe three types of recycling which reduce littering.
2. Determine the impact that recycling of metals will have on our future supply of minerals.

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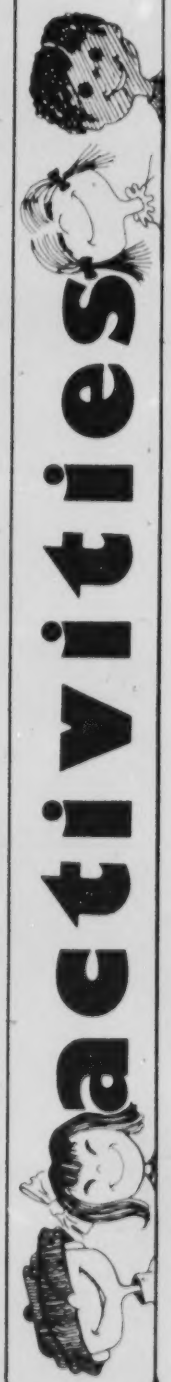
concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

impacts

objective: F - The student will understand that some of these conflicts can be resolved by aesthetic processes.



activities

1. Describe what constitutes objectionable noise. Consider decibel levels, frequencies, variation, etc.

2. Discuss the appearance of vegetable gardens in the yards of homes. Should such gardens be in the front yard? Do such gardens have advantages over ornamental gardens?

3. Compare the ecological impact of wind generated energy with the aesthetic impact caused by the appearance of the windmills.

4. Describe and analyze the aesthetics of competing forms of energy transmission.

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concept: IV - Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

impacts

objective: G - The student will understand that some of these conflicts can be resolved by media-communication and economic processes.

activities

1. Design and conduct a poll to find out how homeowners and residents of apartment houses feel about the advantages and disadvantages of heating with oil, natural gas, coal or electricity.

2. Enumerate the public agencies and private organizations active in their locality which are concerned with environmental issues relating to energy.

3. Debate the clearcut silviculture practices currently used by foresters in the douglas fir of the Pacific Northwest.

4. Describe the impact of recreational vehicles on the environment. Include the family automobile when used for recreation.

5. Describe the aesthetic effects of mining, refining and delivering:

   a. coal
   b. oil
   c. gas
   d. wood
   e. hydroelectric energy
   f. nuclear generated electric energy

6. Construct a list of energy-producing substances and order the method of transport of those substances from aesthetically less pleasing to aesthetically more pleasing.

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concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

objective: A - The student will know that pollution control standards are a matter of legislation and law.

activities

1. Obtain copies of laws in your state that deal with the control of vehicle emission systems. Analyze this information as to how it limits, protects, or provides opportunities for you personally in terms of:

   a. economic benefits
   b. personal liability
   c. personal convenience
   d. health standards

   Project these limits or opportunities five years in the future. How might these affect a career choice?

2. Write the state Environmental Protection Agency and ask for laws regulating power plants, manufacturers, trucks, autos and planes. Compare the laws. Try to determine whether the laws are written fairly.

3. Write a TV drama about those who give testimony before a Senate Committee investigating oil spills in Puget Sound.

4. Determine how a citizen may be involved in setting government environmental standards.

5. Attend a public hearing held by an environmental regulating agency. Identify the role of public hearings in determining government environmental standards.

6. Environmental regulations have caused industry and government to spend additional funds to meet the new requirements.

   a. What was the national expenditure on environmental equipment and controls for the past five years?

   b. What was the cost per U.S. individual?

   c. Determine the increased cost to some industries in meeting environmental compliance including:

      1. Electrical industry
      2. Steel industry
      3. Municipal sewage treatment facilities
      4. Highway construction
      5. Agricultural industry
      6. Others

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activities

Concept V
Objective A

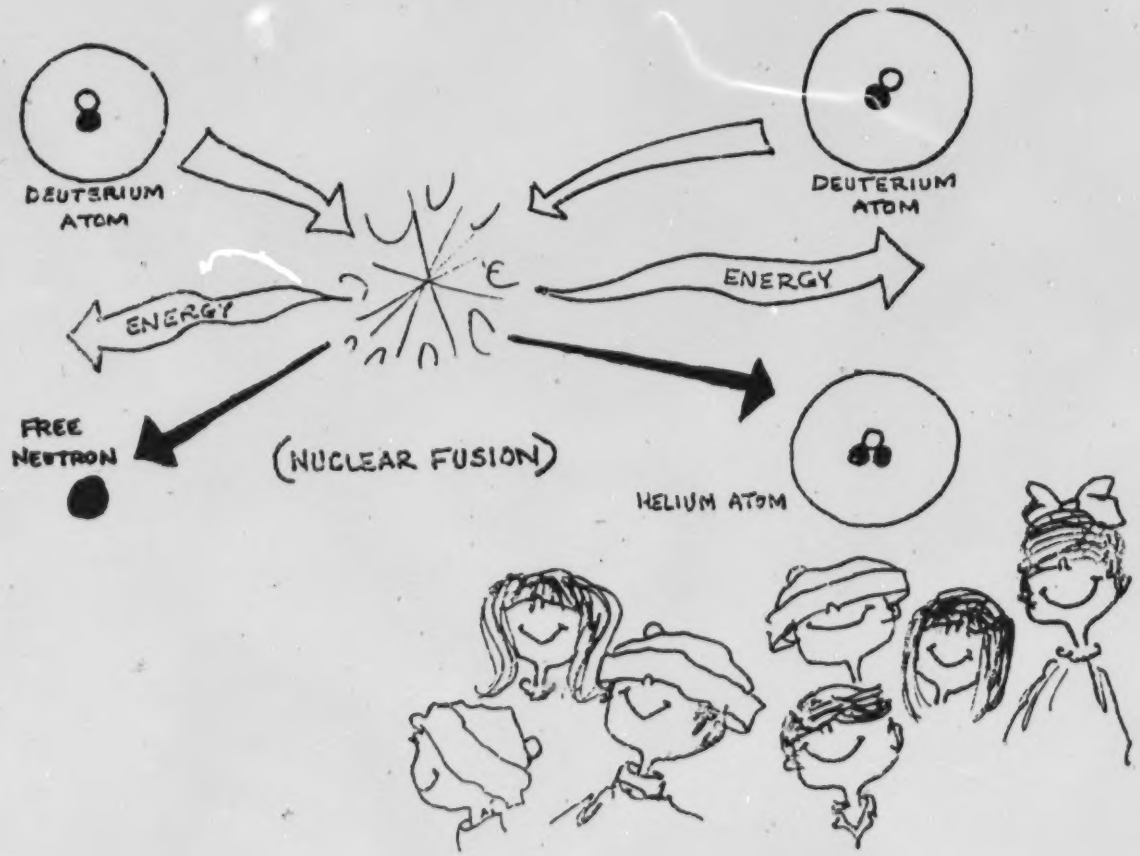
7. Combustion products released to the atmosphere by various industries, government operations, transportation, and individuals have changed the earth's atmospheric make up.

   a. What is the anticipated and/or observed effect on our weather?

   b. What is the present and projected effect on individual health?

   c. What is the present and anticipated effect on the physical structure of our environment?

   d. Provide five beneficial uses or impacts of each combustion process used in this activity.



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concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

objective: B - The student will know that the construction and abandonment of structures involving energy use are of concern to citizens.

activities

1. Construct a model city council in class and then testify before that body about the need for ordinances which will control the construction and abandonment of gas stations.

2. Collect photographs of abandoned buildings and draw up plans for their redesign and remodeling (include systems for dismantling and transporting to new locations if necessary).

3. Collect cast-off industrial packing (styrofoam, crates from motorcycles, electrical appliances, etc.) and use as a materials source to construct sculptural forms. (Styrofoam can be easily cut with a hot wire.)

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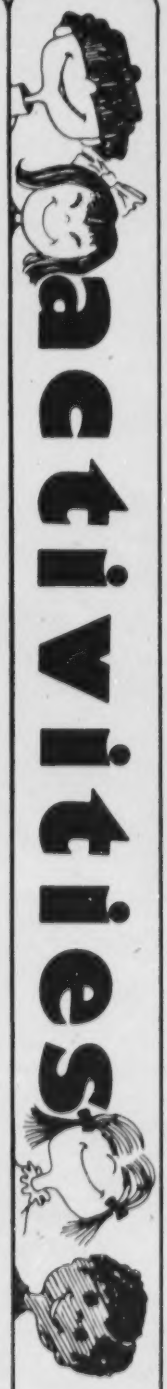
concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

objective: C - The student will know that disagreement exists regarding the ways to control auto emissions.



1. Obtain copies of laws in your state that deal with the control of vehicle emission systems. Analyze this information as to how it limits, protects, or provides opportunities for you personally in terms of:

   a. economic benefits
   b. personal liability
   c. personal convenience
   d. health standards

   Project these limits or opportunities five years in the future. How might these affect a career choice?

2. Find out what people in your community think should be done to control auto pollution. Make findings known to legislators. Invite a city councilman to visit the class so that the issue can be discussed with him.

3. There are about 100,000,000 motor vehicles in the United States. Most of the vehicles are for personal use. Pretend you are to write a law which restricts the use of personal autos to reduce air pollution and space pollution. What will you say in the law?

   What kinds of arguments would you anticipate from opponents of this law? How do other countries get along without the automobile?

4. State ways energy can reduce pollution:

   a. cottrell precipitators
   b. recycling
   c. devices on autos

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concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

objective: D - The student will know that people holding different values differ in their attitudes regarding the need for more or new technical processes.

activities

1. Describe the relationship between the local garbage disposal unit and the local government.

   Describe the disposal methods of solid waste in the community.

   Investigate alternative methods of waste disposal which have less negative environmental impact.

2. Pretend you are the program chairman of a local public service club. Write a speech to explain a bond issue that calls for construction of a sewage treatment plant.

   Identify action groups in the community who might influence decisions concerning construction of such a plant.

   Attend a meeting of a municipal planning group.

   Collect information from such groups as the League of Women Voters and other organizations that might produce pamphlets and other material on such a subject.

   Interview candidates for local office regarding their position on improvements in the municipal treatment of garbage and rubbish.

3. Have a mock discussion of location requirements for a power plant. Choose board of directors; representatives of transportation, labor, city and state government, environment-protection board, etc.

4. Prepare a formal debate on the topic:

   "In technological societies the principle of fragmentation, outrunning the principle of unity, is producing a higher and higher degree of disorder and disunity." Max Ways (Fortune magazine)

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concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

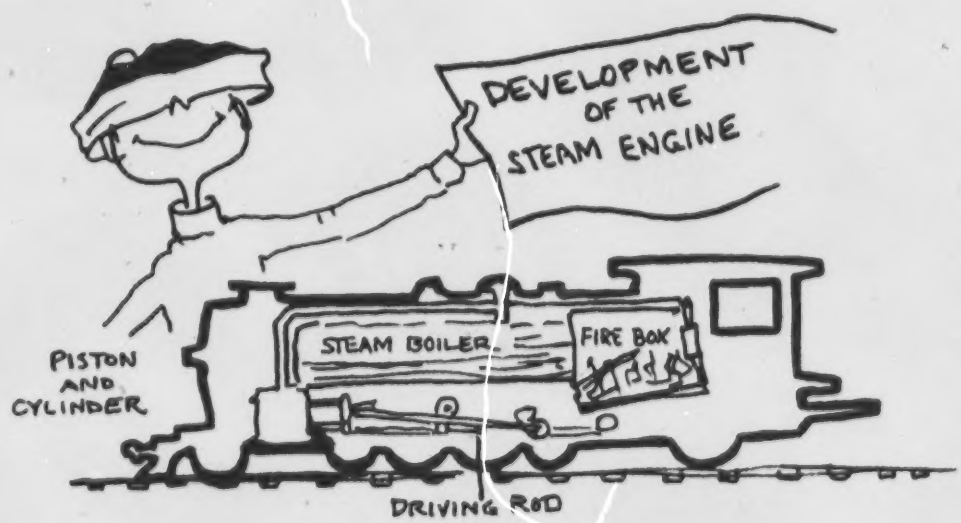
objective: E - The student will know that new processes and devices to reduce pollution require energy use.

activities

1. State ways energy can reduce pollution:

   a. cottrell precipitators
   b. recycling
   c. devices on autos

2. Write an historical conversation which takes place among the following people: Alexander Pope (Essay on Man); St. John the Apostle (Book of Revelations); William Blake (poetry); John Paul Getty (oil industrialist); Ludwig von Mises (economist); Ayn Rand (Atlas Shrugged); George Meany (labor leader); Glen Seaborg (discoverer of U133); and any three other people you care to include.



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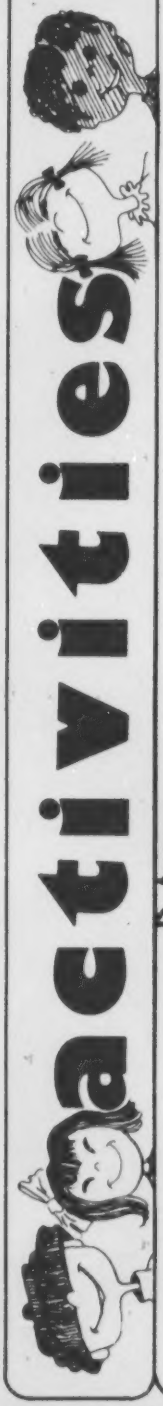
concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

objective: F - The student will know that existing and planned legislation may help or hinder the development of any industrial response to energy needs.



activities

1. Design a tax depletion allowance for industries and power producers that utilize geothermal steam power (or nuclear power, solar power, etc.).

2. Investigate and list the federal laws enacted since 1965 which deal with the environmental circumstances of energy production, use and transmission.

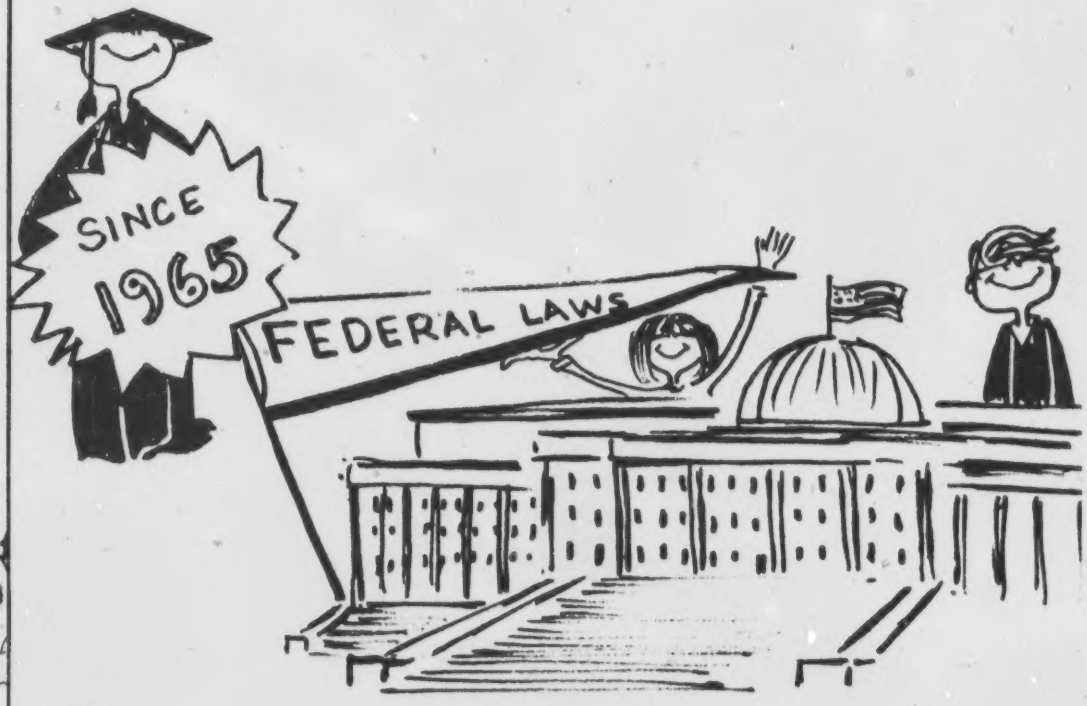
3. Describe the effect of the federal laws requiring environmental impact statements on new construction and development programs in the following areas:

   a. Risk-benefit analysis of the proposed project.

   b. Economic investment in the impact statements.

   c. Major environmental contributions of the statements.

4. Discuss why an environmental impact statement is required by the Environmental Protection Agency.



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concept: V - Efforts to regulate energy producers and users require energy, economic allocation and political effort.

impacts

objective: G - The student will know that different types of human activity require substantially different amounts of energy.

activities

1. Estimate the net energy consumption of governmental agencies in your state; contrast with the net energy consumption of your state's major industrial and manufacturing activity.

2. Using your state budget for last year, compute the total salaries of the employees of the various state energy agencies involved in environmental quality control; contrast the total with corresponding data for energy producers and users in your state.

3. The class will divide into groups. The student will join one of these groups:

   a. manufacturers (including textiles, aluminum, automobiles)
   b. conservationists, Sierra Club
   c. city, county and state planners
   d. oil companies, coal mine owner, foresters
   e. the general public and other interest groups (e.g. parents, teachers, workers)

   Each group must assert its right to control the production and use of the energy resources of the world and must defend its position.

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concept: VI - Some uses of energy are more threatening to ecosystems than are others.

impacts

objective: A - The student will understand that some sources of energy are less threatening to biotic ecosystems than are others.

activities

1. List the reasons why a nuclear energy power plant should not be located near a population center.
(Teacher's Instruction: A debate on this issue is plausible.)

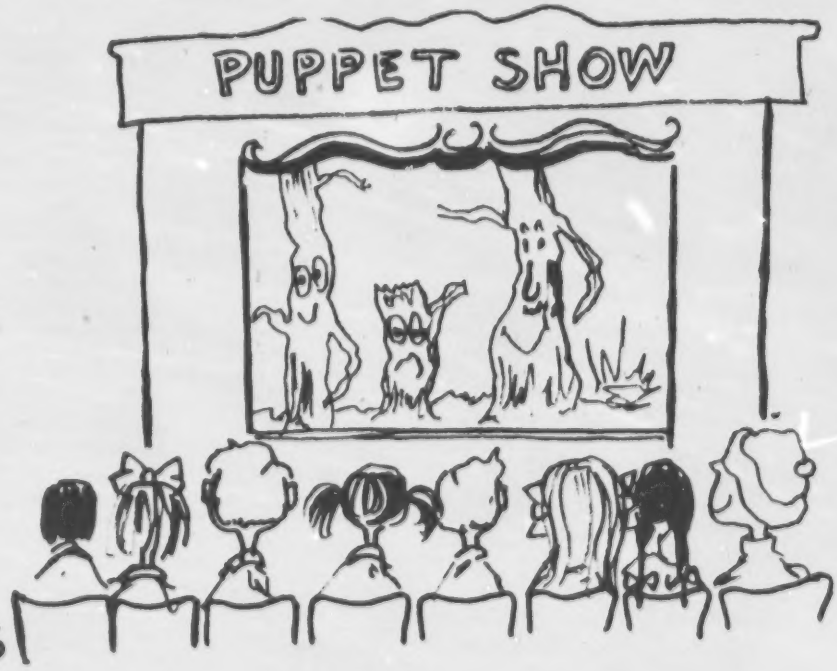
2. List in descending order the amount of radiation naturally occurring in your area; the amount resulting from dental X-rays; the amount resulting from arm or leg bone X-rays; the amount given off by the nearest nuclear power plant per day; the amount used in radiation treatment of cancer. Also consider cosmic Ray Fleet, radioactivity in rock, luminous watch dials. Discuss results.

   Note: Local health department, local dentists, local hospital will be sources.

3. Determine the acceptable limits of pollution for each form of energy currently produced or utilized.

4. Rank the various energy sources in terms of their positive and negative impact on ecosystems.

5. Create a puppet show about a number of different kinds of trees dying from auto emissions in your state's largest city.



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concept: VI - Some uses of energy are more threatening to ecosystems than are others.

impacts

objective: B - The student will understand that some ways of producing, transforming, and using oil are less threatening to biotic ecosystems than are others.

activities

1. Describe three major methods of transporting petroleum products. Compare the environmental impact of each.

2. Compare at least three advantages and disadvantages, in terms of pollution, of home heating with oil, natural gas and electricity.

3. Identify the primary processes used by biotic ecosystems that are disrupted by the various forms of energy extraction, transmission and use.

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concept: VI - Some uses of energy are more threatening to ecosystems than are others.

impacts

objective: C - The student will understand that some human decisions involving energy use are less threatening than others.

activities

1. Pretend you are going on a camping trip 200 miles from home. The length of the vacation is two weeks. You wish to spend as little money as possible, spend as much time in the wilderness as possible and contribute as little pollution as you can. Based on these requirements, select a mode of travel, cooking fuel, housing en route, housing at the camp site, types of activities during the period at camp.

2. What are the effects on society from noise pollution?

3. Table I - U.S. Air Pollutant Emissions, 1965

Sources of Air Pollution	Millions of Tons	Percent of Total
Automobile	86	60%
Industry	23	17%
Electric Power Plant	20	14%
Space Heating	8	6%
Refuse Disposal	5	3%
Total	142	100%

Source: "The Sources of Air Pollution and Their Control" U.S. Public Health Service Publication, No. 1548, Washington, D.C.; U.S. Government Printing Office, 1966.

Using Table 1 as a source of data, respond to the following questions:

a. Which source is the single greatest contributor to air pollution?

b. How does air pollution of all autos compare to the total of air pollutants contributed by industry, cluster power plants, space heating and refuse disposal?

c. If a railroad coal car could hold a load of about 50 tons, how many railroad cars full of pollutants were put into the air in 1965?

Fun math question: If a railroad car were 50 feet long, how long a train would be necessary to carry all the air pollutants?

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Concept VI
Objective C

4. Using the U.S. Catalog of Government Publications, locate and read a governmental report on the effects of strontium 90 on the food chain.

5. Collect at least five songs dealing with environmental conditions and share them with your class.

6. Write and sing a ballad about the various "characters" which are ingredients of smog who meet for the first time in the air over the Willamette Valley.

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concept: VI - Some uses of energy are more threatening to ecosystems than are others.

impacts

objective: D - The student will understand that stable human populations are less threatening to biotic ecosystems than increasing populations.

activities

1. Investigate the relationship between temperature and population growth by setting up yeast cultures of uniform concentration. Place the cultures in areas of controlled temperature such as a refrigerator, suspended in a thermostatically controlled aquarium or an incubator. For several consecutive days measure the population density of the different cultures. Graph the data.

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concept: VII - The environmental and economic consequences of energy use require additional energy.

impacts

objective: A - The student will understand that the side effects of energy use require additional energy.

activities

1. Describe how man has been able to convert items which were once thought to be waste to useful functions.

2. Determine the proportion of total energy required for counteracting pollutant effects.

3. Given any environmental conditions you choose to describe, explain how you can use energy to avoid a deterioration in those conditions.

4. Describe ways to minimize bad effects of obtaining resources:

   a. Coal (mines, strip mining)
   b. Oil (derricks, pipelines, off-shore)
   c. Gas (pipelines, pumping stations)
   d. Wood (clear cutting, transporting)
   e. Electricity (considered as a fuel)
   f. Nuclear fuels (mining)

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concept: VII - The environmental and economic consequences of energy use require additional energy.

impacts

objective: B - The student will understand that energy use creates energy side effects.

activities

1. Describe how energy use creates side effects.
2. List various negative side effects of energy use.
3. List various positive side effects of energy use.

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concept: VII - The environmental and economic consequences of energy use require additional energy.

impacts

objective: C - The student will understand that the use of petroleum for energy creates side effects; energy is required to correct these side effects.

activities

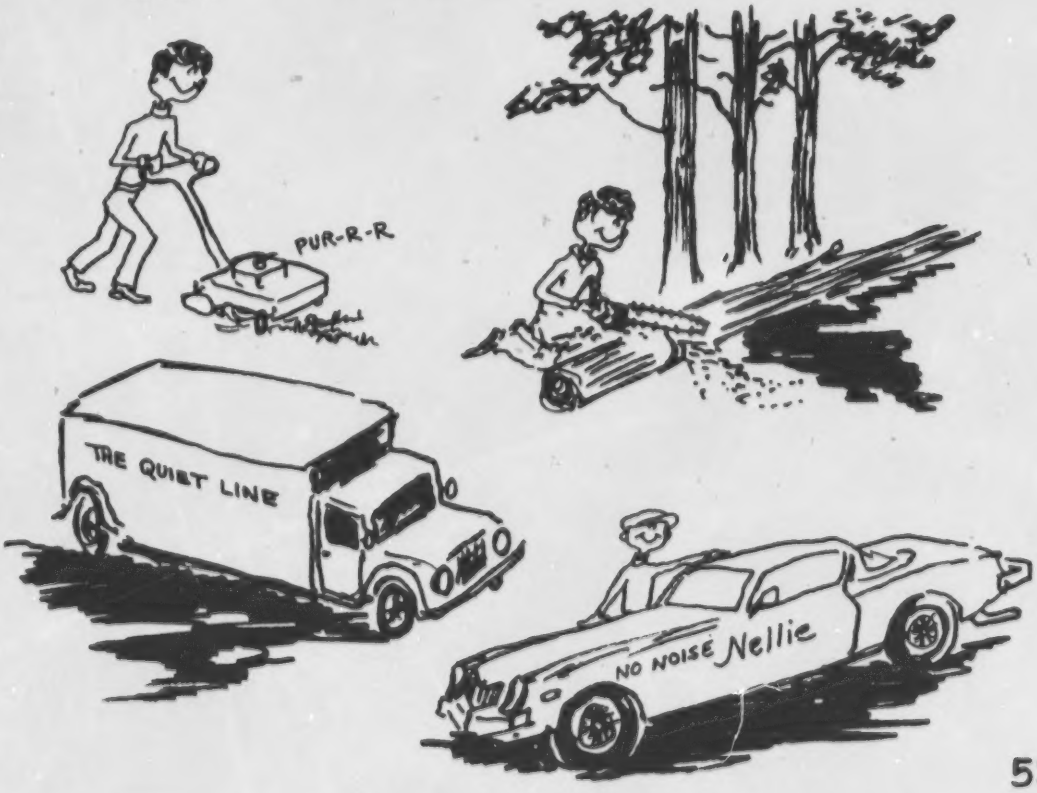
1. Construct a design for the most effective, yet practical exhaust muffler for:

   a. Trucks
   b. Automobiles
   c. Motorcycles
   d. Lawn mowers
   e. Outboard motors
   f. Chainsaws

   Compare the design with the present equipment on these items.

   Compare for noise level the original equipment mufflers on automobiles and motorcycles with "replacement modifications" intended to produce improved performance or "better sound."

2. Create a scenario answering this question: What would have happened if the Torrey Canyon had been a nuclear-powered oil tanker?



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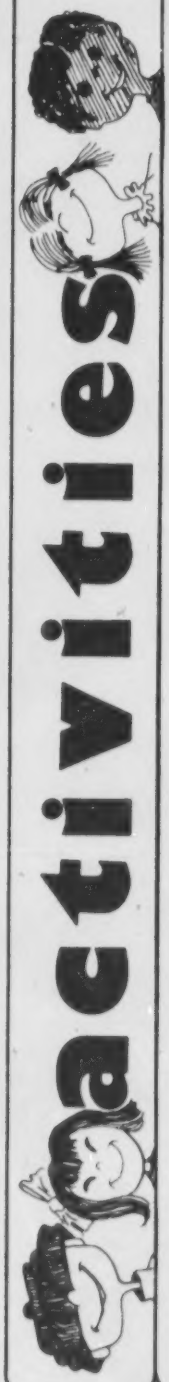
concept: VII - The environmental and economic consequences of energy use require additional energy.

impacts

objective: D - The student will understand that human use of products requires additional expenditures of energy for environmental and waste disposal purposes.



activities

1. Visit your local dump or transfer station. Explain its operation. Discuss possible alternative means of disposal using the energy from solid waste.

2. Investigate the economic and environmental considerations entailed in the process of land reclamation following strip coal mining operations.

3. Compare various ways to contain atomic waste including carbon-steel tanks, burial, salt mine storage, ceramic glass beads, and hydraulic fraction.

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concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

impacts

objective: A - The student will understand that most living Americans are personally heavy polluters.

activities

1. Visit a busy freeway, pedestrian overpass, bridge, or business which is mechanized. Note the noise level before going to the point where the noise is loudest. Stay there several minutes. During this time, record the noise on a tape recorder. (Do the same with an isolated mountain pasture.)

   Return to area with an acceptable noise level. What are some noticeable differences in types of activities?

   Listen to the tape recording later at school. Try to identify the sounds. What solutions can be suggested for reducing or eliminating some of the noise?

   If this were a freeway, what does this suggest about the placement of multi-laned roads in our society? Do these highways infringe on people's rights?

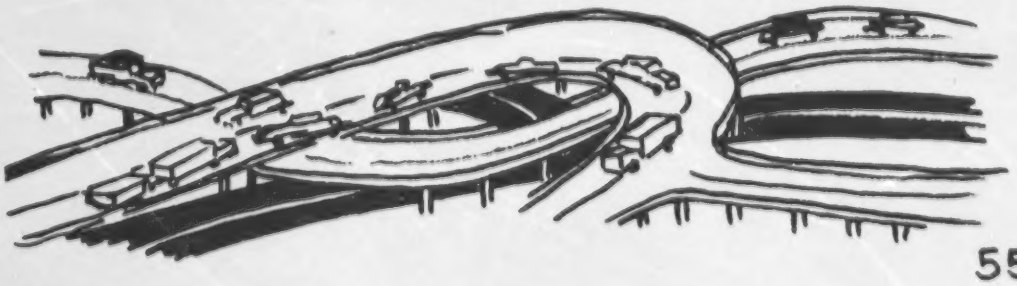
   Teacher's Instructions: Administer an assignment with quiet, with music and with noise. Ask for student reactions.

2. Describe the living conditions of an American farm family and a farm family in India: working hours, lighting, education, water source, cooling practices, diet, recreation, family transportation, family size, medical and dental care. Relate the energy available to the individual.

3. Write a research paper which compares the environmental conditions of these three high powered, industrialized, technologized countries: Japan, Russia and the United States.

4. Draw lines on a world map showing the major sea lanes between oil-producing countries and those countries dependent on petroleum products.

5. Describe the differences in environmental results between the ways that the Mohave Indians used energy and the ways energy is currently used by the residents of Las Vegas.



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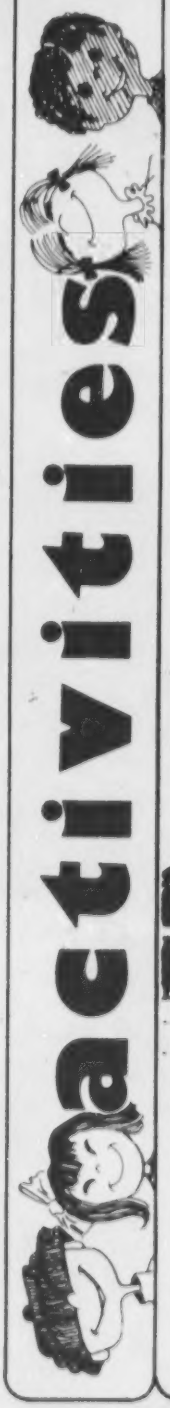
concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

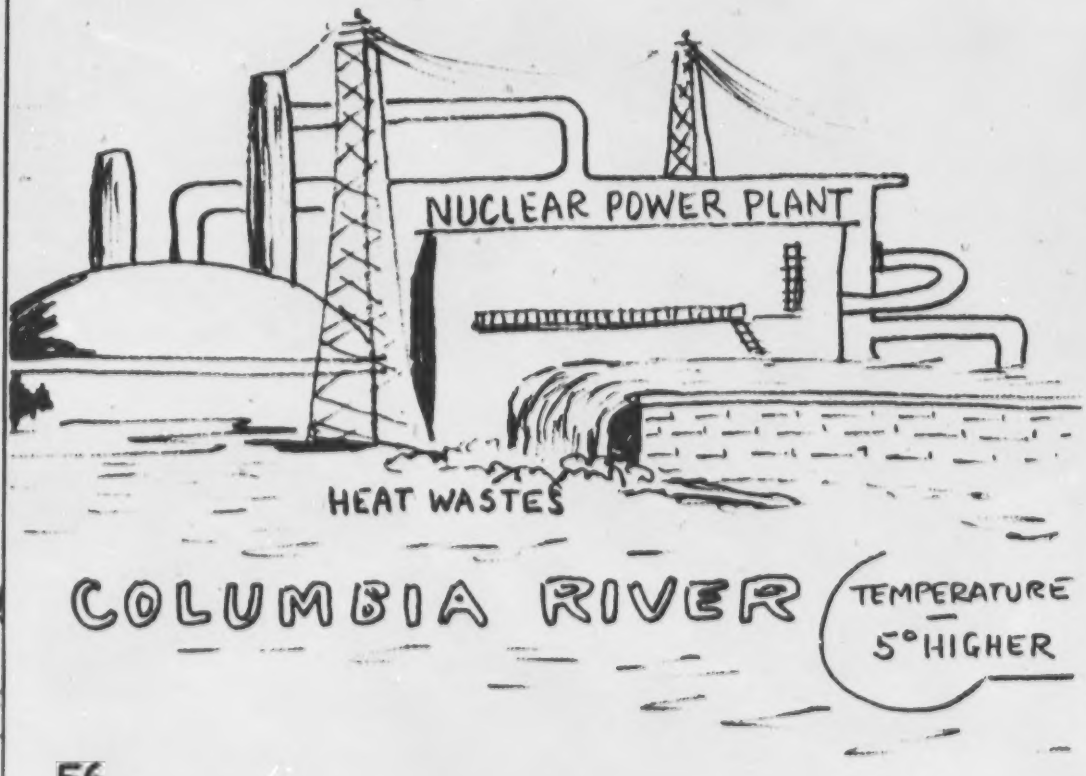
impacts

objective: B - The student will understand that all human activity - personally and collectively - releases heat into the biosphere.



activities

1. If a nuclear power plant were to dispose of its waste heat in the Columbia River, raising the average temperature of the river 5 degrees, what kinds of aquatic life would be affected and how? Construct a model of a modified food chain showing the interrelationships that would be altered.
2. Design a community-agricultural complex that would utilize waste heat from an electrical or industrial complex.
3. List and describe three ways an industrial plant could minimize or eliminate waste heated water discharge to a river.



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concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

impacts

objective: C - The student will understand that industrial and consumer activity produces pollutants.

activities

1. Obtain the pollution index from a local newspaper. Use a line graph and plot the pollution for a period of three or four weeks.

   Along with the pollution chart, keep charts of daily temperature and wind velocity.

   Is there a correlation among temperature, wind velocity, day of the week, and percentage of air pollution? If so, why?

   From this information, what can be said about the leading contributors of air pollution?

2. Describe the characteristics of an industrial society as related to energy.

3. Choose the names for various characters who will appear in a movie in which the main conflict is a struggle between those who favor construction of the Alaskan oil pipeline and those who oppose its construction.

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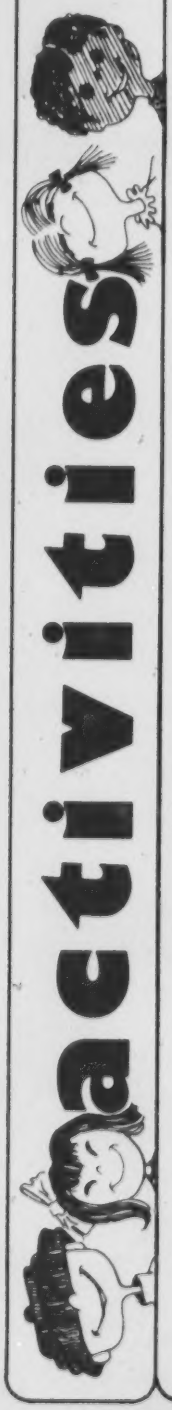
concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

impacts

objective: D - The student will understand that pollutants harm living substance.

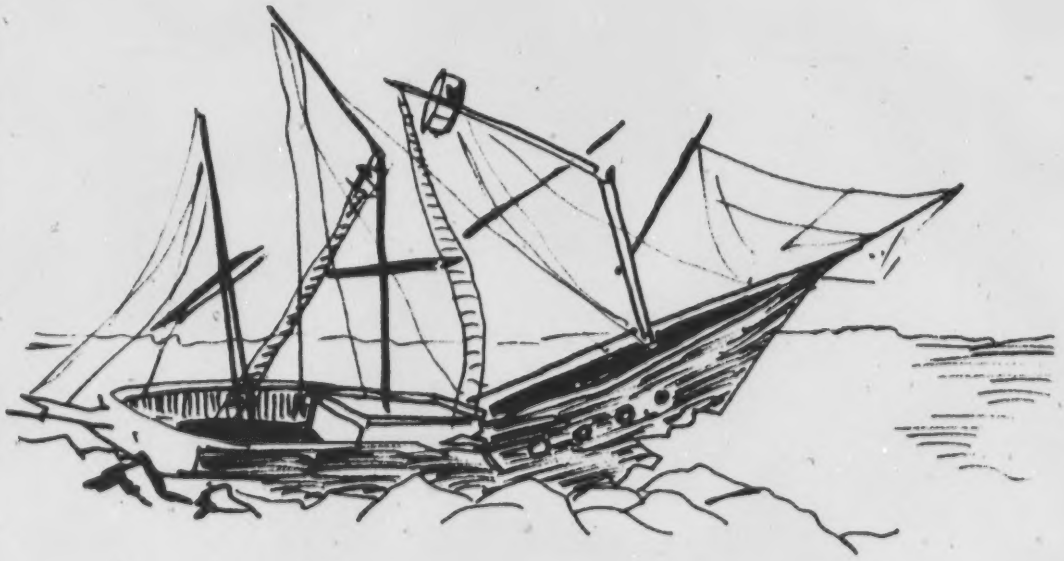


activities

1. Ask a local doctor to visit the class and tell about the physical damage that results from air and water pollution.

2. Predict the psychological impact of increased energy use on any given human group.

3. Write an historical report using at least five different sources about the Torrey Canyon shipwreck off the Scilly Isles.



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concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

impacts

objective: E - The student will understand that most nations/states desire greater energy use.

activities

1. Simulation game: design a court case.

   An underdeveloped nation sends a boy from a primitive tribe to ask the world court for his share of the world's energy.

   Participants:

   a. Judge
   b. Boy from underdeveloped nation
   c. Witnesses
      1. United Nations Representative
      2. U.S. Department of Public Health
      3. Mother of boy from U.S.
      4. Mother of boy from underdeveloped nation
   d. Lawyers (two)
   e. Jury (five-man)
   f. Defendant (boy from U.S.)

   Be sure to include descriptions and quantify the natural resources involved in providing energy for the American boy. Note ways he consumes energy which are not obvious.

2. Analyze the impact of energy imbalance and use which characterized the contending nations during World War I and World War II.

3. Describe the characteristics of a primitive agrarian society as related to energy.

4. Describe the characteristics of an industrial society as related to energy.

5. Draw lines on a world map showing the major sea lanes between oil-producing countries and those countries dependent on petroleum products.

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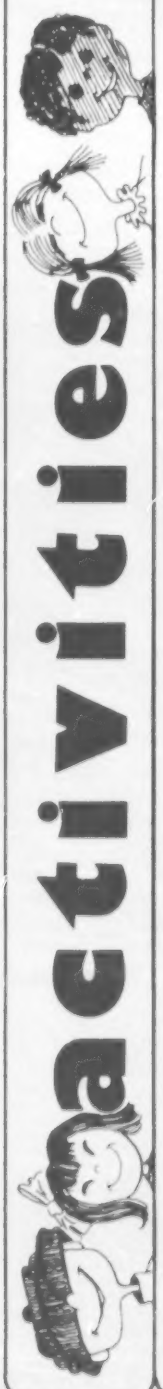
concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

impacts

objective: F - The student will understand that improved living conditions have resulted from extensive energy use.



activities

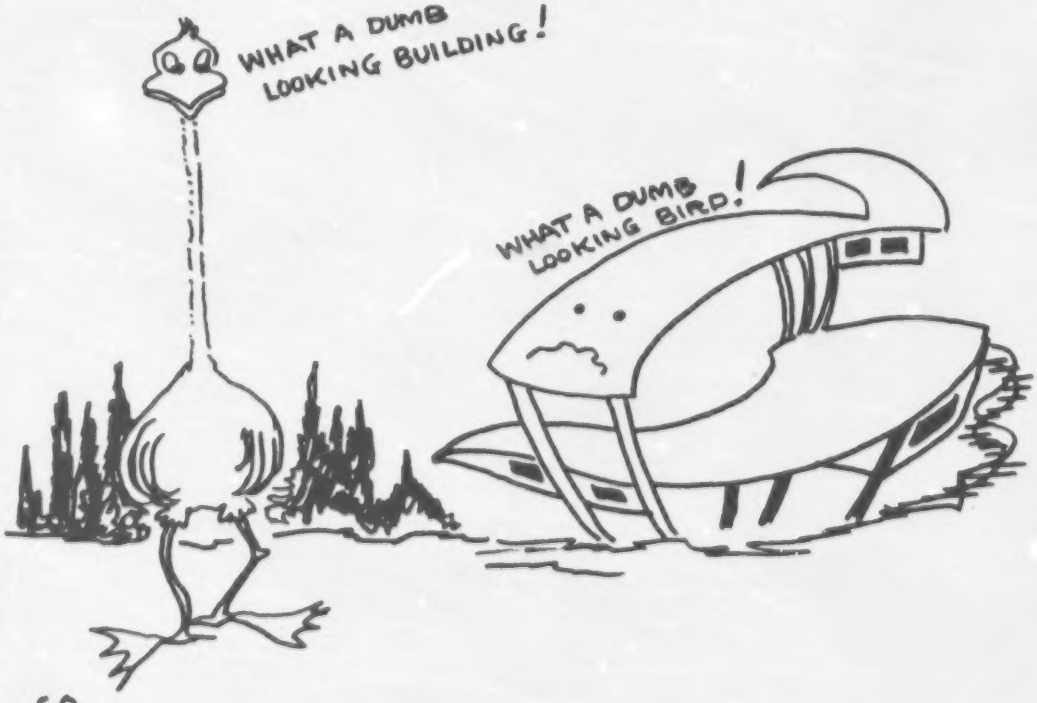
1. Predict the psychological impact of increased energy use on any given human group.

2. Describe the living conditions of an American farm family and a farm family in India: working hours, lighting, education, water source, cooling practices, diet, recreation, family transportation, family size, medical and dental care, and relate the energy available to the individual.

3. Compare death rates and longevity statistics between U.S. and India in 1900, 1930, 1950, 1970.

4. Write a research paper comparing the environmental conditions of these three high powered, industrialized, technologized countries: Japan, Russia, and the United States.

5. Using a copy of Architecture Without Architects as a reference design a "home of the future", keeping in mind a basic list of environmental concepts previously agreed upon by the group.



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concept: VIII - Industrial societies have a greater impact on the environment than do agrarian societies.

impacts

objective: G - The student will understand that people in industrialized nations disagree about which environmental impacts are acceptable.

activities

1. Choose the names for various characters who will appear in a movie in which the main conflict is a struggle between those who favor construction of the Alaskan oil pipeline and those who oppose it.

2. Write and present a melodrama which depicts this concern: "We have mortgaged the old homestead and nature is liable to foreclose."

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concept: IX - Maintenance or improvement of environmental quality necessitates large capital investment and/or reduced energy demand.

impacts

objective: A - The student will know that maintenance or improvement of environmental quality necessitates large amounts of capital investment or reduced demand for energy.

activities

1. Visit an electric generating plant and ask these questions:

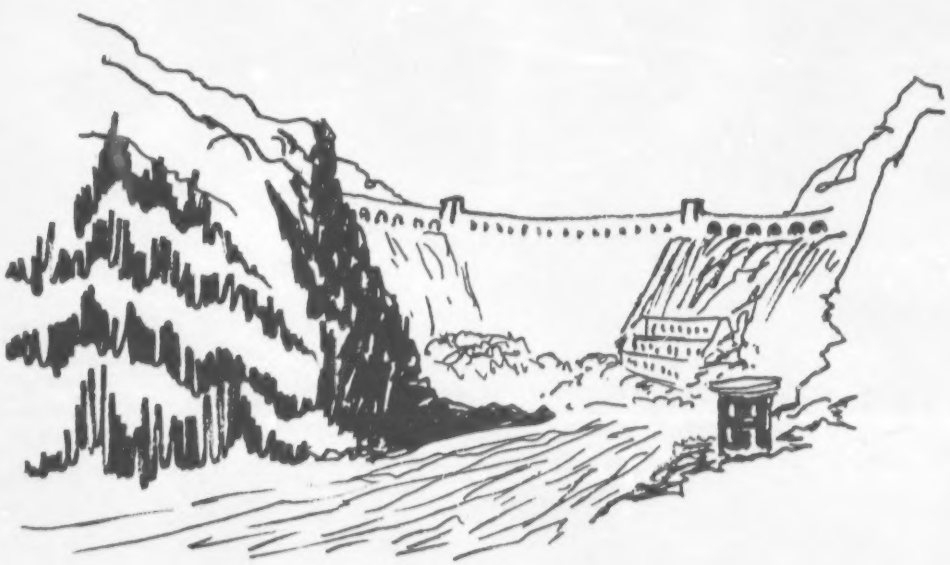
   a. Why was the plant built here?
   b. Could it have been built at a different location?
   c. What is its source of fuel?
   d. Where does fossil fuel come from?
   e. How is air pollution controlled?

2. Visit a pulp and paper plant. Discuss methods of trapping possible pollutants and how these materials are either used or disposed of.

3. Identify the types of equipment used to maintain environmental quality and compute the total cost of such equipment in a coal-fired electric generating plant.

4. Compare the increased capital investment for environmental protection of Alaska's North Slope by oil companies (as seen in both 1970 and 1975) with similar expenditures for other oil projects in 1960.

5. Write a short story about Sheikh Yamani's first day at Harvard School of Business.



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concept: IX - Maintenance or improvement of environmental quality necessitates large capital investment and/or reduced energy demand.

impacts

objective: B - The student will understand that air pollutants create economic loss.

activities

1. Describe the conditions necessary for reduction of pollution caused by the internal combustion engine.

2. List the costs of pollution for:

   a. Air pollutants on material
   b. Helath reduced by CO, PAN

3. Ask the custodian in the school building to describe the economic effects of pollution upon the building. Discuss with him how it has increased his work and how that problem might be alleviated.

4. Argue for or against catalytic converters on automobiles.

5. Identify the various pollution control devices used in the production of coal-fired electrical generating plants.

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concept: IX - Maintenance or improvement of environmental quality necessitates large capital investment and/or reduced energy demand.

impacts

objective: C - The student will know that some industrial processes can use their waste products profitably.

activities

1. Describe how industrial plants could be designed to increase profits and simultaneously reduce or eliminate air and water pollution, i.e., process and sell the effluents.
2. Visit a pulp and paper plant. Discuss methods of trapping possible pollutants and how these materials are either used or disposed of.
3. List ways the Oregon lumber industry uses the sawdust it once disposed of by burning.
4. Determine what economic benefits have been derived from the use rather than disposal of sawdust.

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concept: IX - Maintenance or improvement of environmental quality necessitates large capital investment and/or reduced energy demand.

impacts

objective: D - The student will understand that sewage treatment plants use complex and expensive technology to improve environmental conditions.

activities

1. Visit a sewage treatment plant. Try to find answers to these questions:

   a. Is the waste treatment plant primary?
   b. Is the waste treatment plant secondary?
   c. Is the waste treatment plant tertiary?
   d. Do industries dump wastes into the community treatment plant?
   e. Do industries dump untreated wastes into local water sources?
   f. Do industries bypass the community's waste treatment?
   g. Do homeowners dump untreated wastes into local water sources?
   h. Is some waste bypassed into local water sources during normal dry weather? (1) What percent? (2) How often?
   i. In wet weather, when lines and plants may be filled by storm flow, is some sewage bypassed into local water sources? (1) What percent? (2) How often?
   j. Does the waste treatment plant have enough employees to operate it efficiently on a 24 hour basis?
   k. Does the water treatment plant have enough employees to operate it on a 365 day basis?
   l. Is a training program provided for waste treatment operators in the community?
   m. Does the waste treatment plant provide on-the-job training?
   n. Is the training program paid for by the community?
   o. Is the treatment plant up to date?
   p. Does the community require connection to a public waste treatment plant? (1) How many sewer pipes are not connected to a waste treatment plant?
   q. Does the community prohibit its sewer system from being connected with storm water drains?
   r. Does the community have a sewage treatment problem?
   s. Is the community informed about sewage treatment problems?

   From this information what action should be taken?

2. This is a game designed to encourage students to become aware of decision-making problems concerning a community's sewage treatment system.

   "DIRTYWATER"

   Welcome to the community of "Dirtywater"!!! The purpose of this game is to create a new city known as "Cleanwater." You will begin by recognizing that your community, "Dirtywater", has a sewage treatment problem. You must act or face an ecological disaster.

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activities

Concept IX
Objective D

OBJECTIVES:

a. To develop alternative strategies in community planning as they relate to the improvement of a water supply.

b. To express through discussion and debate the economic implications of decision-making.

c. To develop attitudes through role playing techniques in an attempt to achieve effective changes.

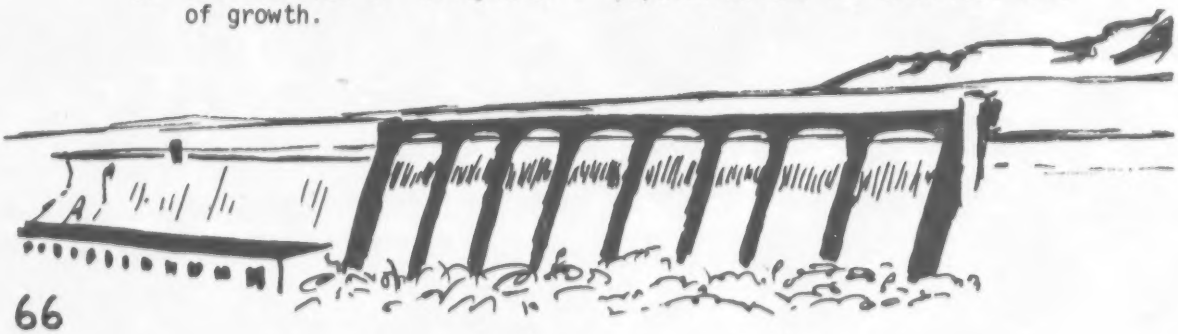
PREPARATIONS:

a. Using arbitrary figures established by your group or class, prepare a map reflecting your version of "Dirtywater" that shows:

   1. Boundary lines of your sewer district.
   2. Existing and proposed recreational use boundary lines.
   3. Existing and proposed residential use areas within your boundary lines.
   4. Streams, lakes, and other bodies of water showing the location and direction of flow of major streams.
   5. Public water source showing the location of wells and other sources of public water supply, water storage reservoirs, and other structures relating to public water sources.
   6. Sewage treatment system showing the extent of the area included in your community and description (i.e., drawing of current disposal system.)
   7. If desired, the topography of the community, showing pertinent ground elevations.

b. Again using arbitrary figures, decide the kinds of industries, businesses, etc. that are located in "Dirtywater" and their expected rate of growth.

c. Set the size of "Dirtywater's" population and its estimated rate of growth.



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Concept IX
Objective D

PROCEDURE:

Divide the class into groups of reasonable size and allow them to represent the various segments of the community. One group should represent the mayor; another, the city water commission; another group represents the homeowners of the community; and another, the city council. Remaining groups should represent the various types of industry and business that are located in the community. Try to include a few that rely heavily on water, such as a food processing company, pulp mill, or a nuclear plant.

Because "Dirtywater" is faced with a sewage treatment concern, a variety of problems are presented to the community, to be faced by the community, one at a time. For example, the first class interaction with role-playing might be to answer the question: how should the sewage treatment plant be financed? The different groups reflecting their position, representing the various roles in the community, must respond to this question and funds should come through increased taxation. The homeowners might definitely oppose such a measure because they feel the pulp mill in town pollutes the water more than they do. They suggest that the industries finance the new treatment plant. Obviously, the alternatives and possible solutions are endless and should stimulate further questioning, discussion and research.

PRESSURE POINTS:

A variety of pressure points or restrictions to alter the direction of the game might prove intriguing. The groups could think of such measures and impose them on each other. For example, the Water Commissioner's group might be restricted in their authority by not being able to control who can and cannot use the water, or the city budget group might be placed with a restriction for spending no more than ? number of dollars from their budget on sewage treatment. The possibilities are endless. The class might think of other ways to vary this activity, like making a fate card out of 3" x 5" paper and a spinner. One side of the card is marked "support" and the other side is marked "oppose". The purpose would be to have a direction of choice imposed on them.

Finally the groups must decide which solution is the best answer to each of the problems in their community and how it may be effectively carried out. When the problem of financing has been answered, for example, the groups are now ready to tackle a new problem, such as training and management, size of plant (effectiveness) and location of plant.

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Concept IX
Objective D

NOTE: Be sure to handle only one problem at a time to avoid confusion and also to allow the maximum effectiveness from each group. Hopefully, the students will begin to empathize with the decision-makers in their own community and realize the seriousness of the problems related to sewage treatment and water quality.

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concept: IX - Maintenance or improvement of environmental quality necessitates large capital investment and/or reduced energy demand.

impacts

objective: E - The student will know that disagreements exist concerning the environmental quality to be secured, the capital allocations involved and the acceptable reduced energy demand.

activities

1. PURPOSE:

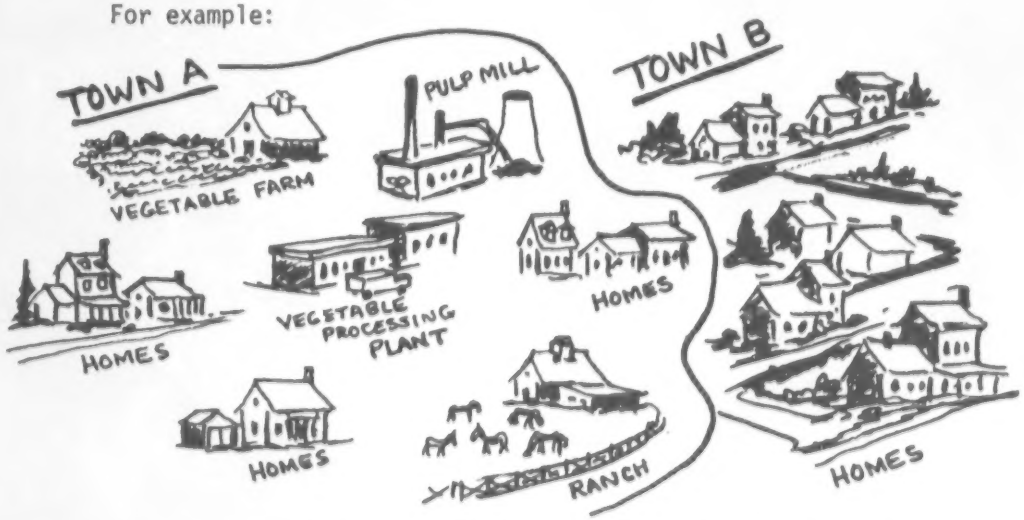
   An Aquatic Studies Game to help students determine who is responsible for treatment financing.

   MATERIALS - none.

   PROCEDURE:

   Describe a typical town to the class, including industries, farms, and processing, residential areas, rivers and/or lakes, etc. Present a situation of rising pollution and population and the need for better treatment of water.

   For example:



   Town B is complaining that the water they receive is of a poorer quality than the water received by Town A (same river). Town A realized the need to purify their used water, but cannot decide how to finance a treatment plant. Role play town positions: mayor, cattle rancher, vegetable farmer, owner of processing plant, owner of pulp mill and townspeople. Let the group of students that represent these positions determine who should pay.

   *Taken from Aquatic Studies by "Time" Smith KCTS-TV.

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activities

Concept IX
Objective E

2. Write, debate, discuss, illustrate or depict: Why do you think that Max Ways, a member of the Board of Editors of Fortune magazine, the well-known monthly business magazine, would make the following statements as he did in his February, 1970 issue of the magazine: 1) "The three million high-technology U.S. farmers put more adverse pressures on their land and rivers than the hundred and fifty million low-productivity peasant families of China put on their land and rivers." 2) "If the (U.S.) population declined and technology continued to breed, without any improvement in the arrangements for its prudent use, a small fraction of the present U.S. population could complete the destruction of the physical environment while jostling one another for room." 3) "Retreat to the 1970 level of technology, while not giving long-range protection to the environment, would place the median American standard of living far below the 1970 poverty line. Among the consequences of such a retreat would be the closing of 75% of the present colleges and most of the high schools. We would give up not only automobiles and airplanes, but also mass education and social sources. Grandpa would return to living in the abandoned hencoop." 4) "In two areas, air and water pollution, a moment's reflection should convince anybody that the market, as now set up, is rigged against the environment. A hundred and fifty years ago it was almost unimaginable that clean water, much less clean air, could become scarce in the U.S. economy. Rightly these resources were then considered common property and used without charge. The price of everything else the economy uses - land, minerals, food, labor, time - become dearer. But clean air and water, though now precious, are still left out of the pricing system, still free of charge." 5) "By (the) combination of government police power and taxing power we can turn the market toward protection of the environment or at least achieve its 'neutrality'." 6) "It is by no means clear that automobiles now carry taxes equivalent to the true social costs incurred in their use and disposal. If we ever become serious about the preservation or restoration of public transport in American cities the first step would be to make sure that public policy is not subsidizing the automobile." 7) "(Environmental) problems have become so huge that we would not necessarily make a dent in them with all the profits of American business." 8) "The U.S. will probably reach saturation in manufactured goods in any event at some point in the next fifty years, if only because the time to use all the things we buy is becoming scarce."

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concept: X - New technologies and careers have resulted from the environmental impact of energy.

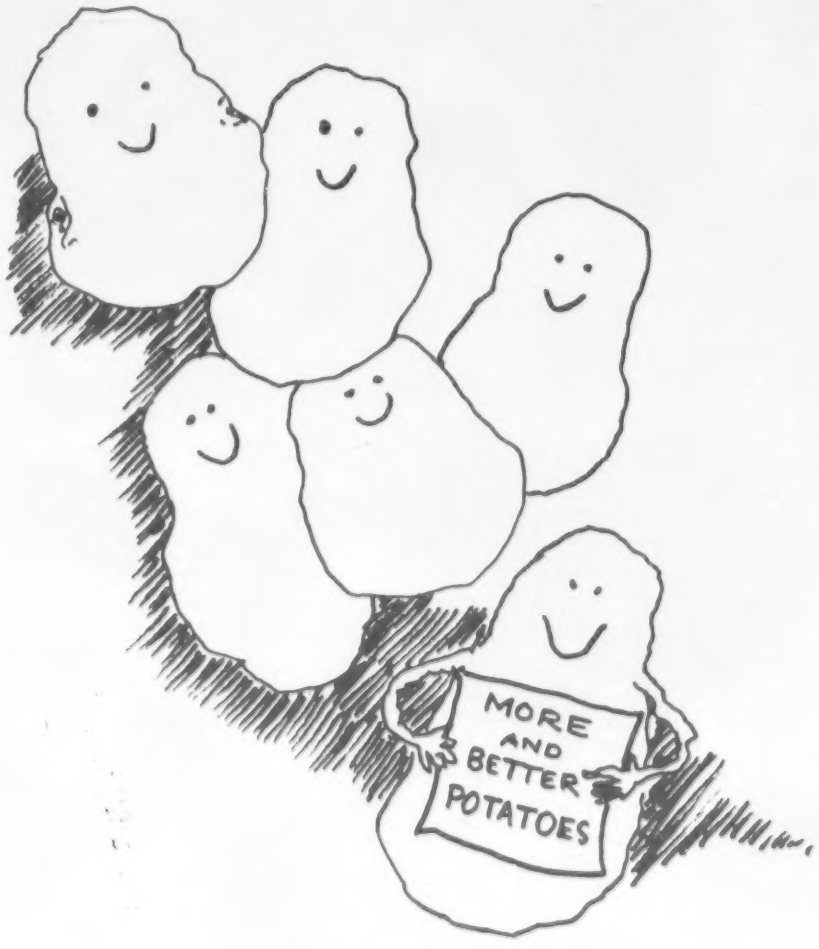
impacts

objective: A - The student will know that new technologies and careers have resulted from energy production and use.

activities

1. Identify the technological processes that expanded the potato processing plants in the Pacific Northwest.

2. Identify five industrial occupations that are energy dependent - compared to occupations in the 19th Century and earlier.



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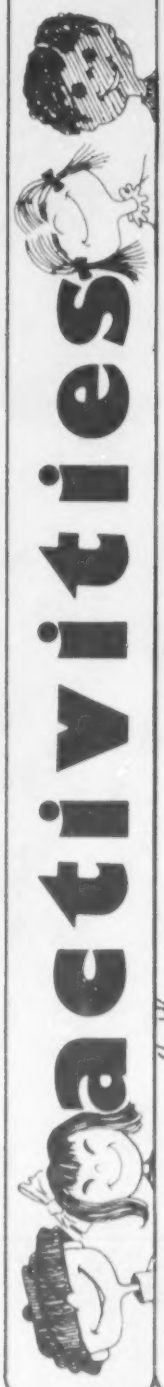
concept: X - New technologies and careers have resulted from the environmental impact of energy.

impacts

objective: B - The student will understand that new technologies have replaced or joined old technologies as a result of energy production and use.



activities

1. Discuss the use of sewage and garbage in a municipal composting operation. Identify the roles of sewage and garbage and the complementary effects of each.
2. Identify ten industrial uses for computers.
3. List and describe the electronic devices that made rock music possible and popular.
4. List some vocational implications of a shift in dependence upon one energy source to another.
5. Give reasons for the location of aluminum and rare metal processing plants in the Northwest.

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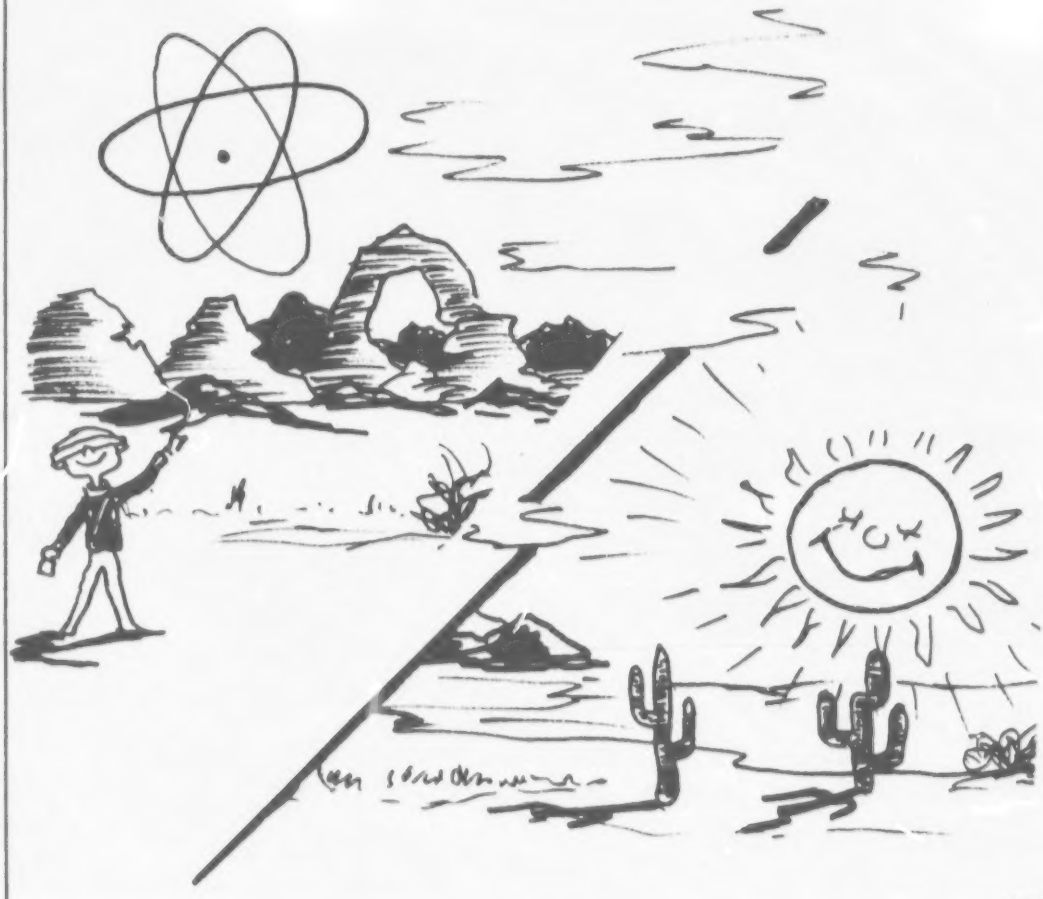
concept: X - New technologies and careers have resulted from the environmental impact of energy.

impacts

objective: C - The student will know that new careers have resulted from energy production and use.

activities

1. List jobs needed to do the research for pollution control.
2. List jobs needed to monitor and control pollution.
3. Write the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, for the series of pamphlets called Employment Outlook. Study the careers in pollution control and list what should be their educational requirements.
4. Using the Dictionary of Occupational Titles, list the job titles of computer-related jobs.



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